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Original Research Article

Evaluation of Plum Cultivars based on Storage Behaviour under Ambient Conditions of Kashmir

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A B S T R A C T

An experiment was conducted at Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar, Kashmir during the year 2017-18. The present study consisted of six plum cultivars viz. Burbank, Stanley, Friar, Wickson, Santa Rosa and Satsuma of uniform age replicated thrice in a Randomized Complete Block Design (RCBD). In the experimental year, physiological loss in weight (%), fruit firmness (kg/cm^2), SSC, titratable acidity and SSC/Acidity ratio were recorded. The data recorded revealed that the physiological loss in weight on 3, 6 and 9 days of ambient storage was recorded to be maximum in cultivar 'Satsuma' (12.57, 23.02 and 28.33%), and minimum in the cultivar 'Stanley' (4.54, 10.89 and 19.05%). The firmness on 3, 6 and 9 days of ambient storage was recorded to be highest in cultivar 'Stanley' (2.40, 2.17 and 1.86 kg/cm^2) and lowest in cultivar 'Satsuma' (1.63, 1.47 and 1.13 kg/cm^2). The soluble solid content (SSC) on 3, 6 and 9 days of ambient storage was recorded to be maximum in the cultivar 'Santa Rosa' (17.43, 19.20 and 21.80 %) and minimum in cultivar 'Satsuma' (13.37, 14.03 and 14.67%). The acidity on 3, 6 and 9 days of ambient storage was recorded to be highest in cultivar 'Burbank' (1.65, 1.50 and 1.35%) and lowest in cultivar 'Stanley' (0.48, 0.40 and 0.31%). Soluble solid content/Acid ratio on 3, 6 and 9 days of ambient storage was registered to be maximum in 'Stanley' (35.48, 45.90 and 60.54) and minimum in cultivar 'Burbank' (8.22, 9.38 and 10.89) The study concluded on the note that cultivars Stanley better storability and consumer acceptability and therefore can be a better alternative to end the monotony of 'Santa Rosa' in temperate regions of Kashmir.

Keywords

Prunus salicina, temperate zone fruits, family Rosaceae

Introduction

Plums are the most taxonomically diverse of stone fruits which belongs to genus *Prunus* of sub family Prunoideae (*Amygdaloideae*) and family Rosaceae (Potter *et al.*, 2007). They are temperate zone fruits, but are widely grown throughout the world, from the cold climate of Siberia to the sub-tropical conditions of the Mediterranean region (Son, 2010). The most commonly grown species are *Prunus domestica* L. (2n = 6x = 48) and *Prunus salicina* L. (2n = 2x = 16). *Prunus domestica* is the most important plum species worldwide. *Prunus domestica* is native to areas between Black Sea and Caspian Sea and the adjoining areas of Persia and Asia Minor whereas *Prunus salicina* is native to

China but was domesticated in Japan and subsequently was introduced to different parts of the world. Although in India, plum was first introduced in 1870 by Alexander Counts at Mashobra (Shimla) in Himachal Pradesh but it was commercialized by Prof. W B Hodgson from Florida at Fruit Farm Kandaghat or erstwhile Patiala state in 1935 (now District Solan Himachal Pradesh), thereafter grown in the hilly regions of Jammu and Kashmir, Uttarakhand, Uttar Pradesh and Tamil Nadu. Its area and production in India is 24,000 ha and 89,000 MT and in Jammu and Kashmir 4,083 ha and 11,860 MT respectively (Anonymous, 2018-19). The fruits of plums are used as fresh, dried or processed into jam, marmalade, juice, brandy etc (Voca *et al.,* 2009 and Milosevic *et al.,* 2013). Calorie value of plum fruits is low, and highly nutritive (Voca *et al.,* 2009). Carbohydrates, organic acids, pectin, tannins**,** vitamins and enzymes are substances that are significantly present in the fruits of plums and determine its nutritional value and taste. In addition to the nutritional value of fruits, plums have a significant role in the prevention and treatment of certain disorders such as cardio-vascular, renal, stomach and other illnesses (Usenik *et al.,* 2008). The plum fruits are rich source of minerals that are essential for the proper functioning of the organism (Jacimovic *et al.,* 2011, Milosevic and Milosevic 2012 and Ionica *et al.,* 2013] as well as phenolic compounds which show high antioxidant activity(Gadze *et al.,* 2011 and Nisar *et al.,* 2015). The quality parameters of plums are usually determined by a combination of external characteristics (size, color, visible physiological defects) and internal properties (firmness, sugar and acid content in pulp), which are well studied so that they meet consumer preferences (Crisosto *et al.,* 2004).

The optimum fruit quality and storage behaviour of plum hinges upon the stage at which the fruit is harvested. Physico-chemical changes during storage of fruits are used as important criteria for determining the optimum storage epoch which are essential to work out the transportation mode from one place of production to distant markets. Thus, there is need to assess the storage potential of different cultivars for their better shelf life. However, post-harvest behaviour of plum vary, depending on various factors like cultivar, rootstock, soil, agro climatic conditions, growth and development pattern including flowering, fruiting, maturity, chemical composition of fruits as well as storage conditions. Keeping these facts in mind, the present investigation was undertaken to assess the storability of different cultivars of plum at ambient conditions, which may be useful to orchardists, traders, processors and exporters.

Materials and Methods

The present investigation was carried out in the orchard of Division of Fruit Science, Sher-e-Kashmir University of Agricultural Science and Technology, Shalimar, Srinagar, Kashmir in the year 2017. Bearing plum trees of different cultivars of uniform age (4 years old), rootstock (seedling rootstock), vigour, health, bearing and agronomical practices were selected for the trial. The trees were planted in square system of planting and maintained under uniform cultural practices as per package and practices followed during the period of study. Six cultivars of plum viz, Burbank, Stanley, Friar, Wickson, Santa Rosa and Satsuma were investigated. The experimental design was randomized complete block design (RCBD). Each treatment comprised of a single plant and was replicated three times. After harvesting, fruits were kept in wooden trays consists of 60 fruits per replication of each cultivar and stored under ambient storage conditions (24$\pm$ 3^{o}C) for 9 days. Observations on physico-

chemical parameters of fruits were recorded at 3 days intervals. Physical attributes like physiological loss in weight (%) and fruit firmness (kg/cm^2) were recorded during storage. The physiological loss in weight was measured by subtracting the initial weight from final weight and expressed as percentage. The fruit firmness was measured with the help of a penetrometer (Model FT-327, Italy) using 8 mm stainless steel probe and results were expressed as kg/cm^2. The chemical characteristics of the fruits *viz*. TSS, titratable acidity and TSS/Acidity ratio were recorded by using the methods described by Ranganna (11). The data generated were subjected to statistical analysis as per the procedures described by Gomez and Gomez (1984).

Results and Discussion

The data pertaining to different characteristics are presented in Table-1 and 2. Among the cultivars, minimum physiological loss in weight of 3, 6 and 9 days of ambient storage (Table-1) was recorded in the cultivar Stanley (4.54, 10.89 and 19.05%)followed by Friar (6.60, 12.41 and 20.84%) and Santa Rosa (9.88, 15.63 and 21.85%). The maximum physiological loss in weight of 3, 6 and 9 days of ambient storage was recorded in cultivar Satsuma (12.57, 23.02 and 28.33%).On 3rd day, firmness was recorded highest in cultivar Stanley (2.40 kg/cm^2) followed by Friar (2.18 kg/cm^2) and Santa Rosa (1.96 kg/cm^2). Cultivar Burbank (1.75 kg/cm^2) was at par with cultivar Wickson (1.74 kg/cm^2). Least firmness was recorded in cultivar Satsuma (1.63 kg/cm^2). On 6th day, firmness was recorded highest in cultivar Stanley (2.17 kg/cm^2) followed by cultivar Friar (1.92 kg/cm^2) and Santa Rosa (1.70 kg/cm^2). Lowest firmness was recorded in cultivars Satsuma and Wickson (1.47 kg/cm^2). On 9th day, firmness was recorded highest in cultivar Stanley (1.86 kg/cm^2) followed by Friar (1.70 kg/cm^2) and Santa Rosa (1.49 kg/cm^2). Cultivar Burbank (1.32 kg/cm^2) was at par with cultivar Wickson (1.23 kg/cm^2). Lowest firmness was observed in cultivar Satsuma (1.13 kg/cm^2).

Soluble solid content was significantly influenced during storage (Table-2). The highest SSC on 3, 6 and 9 days of ambient storage was recorded in the cultivar Santa Rosa (17.43, 19.20 and 21.80 %) followed by Stanley (17.03, 18.20 and 18.97%)and Friar (15.23, 15.90 and 16.83%). While as lowest SSC was noticed in Satsuma (13.37, 14.03 and 14.67%) which was statistically at par with Wickson (13.40, 14.27 and 15.37%) and Burbank (13.57, 14.10 and 14.70%).The highest acidity on 3, 6 and 9 days of ambient storage was recorded in cultivar Burbank (1.65, 1.50 and 1.35%) which was statistically at par with Santa Rosa (1.62, 1.48 and 1.31%). Lowest acidity was recorded in cultivar Stanley (0.48, 0.40 and 0.31%) followed by Friar (0.62, 0.54 and 0.44%).Maximum SSC/Acid ratio on 3, 6 and 9 days of ambient storage was registered in Stanley (35.48, 45.90 and 60.54) followed by Friar (24.59, 29.45 and 40.71) whereas minimum SSC/Acid ratio on 3, 6 and 9 days of ambient storage was noticed in cultivar Burbank (8.22, 9.38 and 10.89).

As we know upto 20% PLW, fruits are eatable. This indicated that the shelf life of Stanley was maximum (> 9 days) whereas minimum shelf life was recorded in cultivar Satsuma (< 6 days). Fruit firmness is an excellent indicator of maximum maturity. The decrease in the fruit firmness is a physiological behaviour occurring during maturation on the tree (Abbott, 1999). According to Peirs *et al.*, (2000), fruit picked too early stayed firmer over the whole storage period. Fruit firmness of those picked at the last harvest date, was 45% that of fruit picked at the first harvest.

Table.1 Changes in fruit physical characteristics during storage of 3, 6 & 9 days interval under ambient condition

Cultivars	Parameters					
	Physiological loss in weight (%)			Firmness (kg/cm^2)		
	3 days interval	6 days interval	9 days interval	3 days interval	6 days interval	9 days interval
Burbank	11.92	20.83	25.65	1.75	1.48	1.32
Stanley	4.54	10.89	19.05	2.40	2.17	1.86
Friar	6.60	12.41	20.84	2.18	1.92	1.70
Wickson	10.11	20.99	26.00	1.74	1.47	1.23
Santa Rosa	9.88	15.63	21.85	1.96	1.70	1.49
Satsuma	12.57	23.02	28.33	1.63	1.47	1.13
CD (P≤0.05)	**0.895**	**1.038**	**0.811**	**0.083**	**0.092**	**0.091**
C.V.	**5.21**	**3.25**	**1.89**	**2.45**	**3.12**	**3.64**

Table.2 Changes in fruit chemical characteristics during storage of 3, 6 & 9 days interval under ambient conditions

Cultivars	Parameters								
	SSC (^{o}B)			Acidity (%)			SSC/Acidity		
	3 days interval	6 days interval	9 days interval	3 days interval	6 days interval	9 days interval	3 days interval	6 days interval	9 days interval
Burbank	13.57	14.10	14.70	1.65	1.50	1.35	8.22	9.38	10.89
Stanley	17.03	18.20	18.97	0.48	0.40	0.31	35.48	45.90	60.54
Friar	15.23	15.90	16.83	0.62	0.54	0.44	24.59	29.45	40.71
Wickson	13.40	14.27	15.37	0.91	0.67	0.57	14.76	21.51	26.15
Santa Rosa	17.43	19.20	21.80	1.62	1.48	1.31	10.76	12.47	15.28
Satsuma	13.37	14.03	14.67	1.43	1.24	1.10	9.35	11.37	13.41
CD (P≤0.05)	**0.554**	**0.660**	**0.777**	**0.058**	**0.058**	**0.089**	**0.923**	**1.385**	**1.363**
C.V.	**2.11**	**2.38**	**2.63**	**2.69**	**3.09**	**5.38**	**3.29**	**3.92**	**3.02**

Stanley is a popular prune-plum cultivar. Prune-plums have a somewhat longer shelf life than other plums because of firmer flesh (2.59 kg/cm^2) and higher sugar content. Our results are supported by the findings of Butac *et al.,* (2011) who reported that in the interest of easy transportation, long shelf life and storability, breeders aim to develop cultivars with firm flesh of 2.5-3.0 kg/cm^2.The observation of the present study regarding Soluble solid content / Acid ratio (during storage) are in tune with the results of Ohata *et al.,* (2017) who reported values ranging from 20.0 to 52.8 and had a good taste. These findings also indicate that Stanley which is a late-ripening cultivar, is suitable for table use in the temperate zone because it produce high yield and good taste quality. Bilal *et al.,* (2015) reported a larger variation in shelf life from 23.78 days (Bluefre) to 9.77 days (D-agen). Every cultivar of plum fruits has its own keeping period which might be related to

the solid contents of the fruit, temperature and the stage in which the fruits are harvested. Vangdal *et al.,* (2007) observed difference in the shelf life of different cultivars of plum fruit and they were characterized to have short, medium and long shelf life.

From the present study, it can be concluded that cultivars 'Stanley' and 'Friar' proved to be promising with better storability and consumer acceptability and therefore can be a better way to end the humdrum of 'Santa Rosa' in temperate regions of Kashmir. Thus these two cultivars can also prove useful in extend the season, fulfill consumer's ever-changing taste and provide better remitment to the growers.

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