



Variability in Physico-Chemical Characteristics of Ber (*Zizyphus mauritiana* Lamk) Varieties Under Rainfed Conditions of Shivalik Foothills of Himalayas

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Five ber varieties were evaluated for various physico-chemical characteristics and fruit rot incidence during 2010 and 2011. Highest fruit weight (21.2 g) and fruit yield (99 kg tree⁻¹) was recorded in cultivar Sanour 4 and the minimum 8.8 g and 63 kg tree⁻¹ was observed in ZG 2. Fruit length, TSS, acidity and ascorbic acid varied from 2.4 to 5.0 cm, 12.95 to 25.45 per cent, 0.41 to 0.74 per cent and 77.9 to 123.3 mg 100 g⁻¹, respectively. Varieties viz. Ranjari Selection-1, Ranjari Selection-2, Raya Selection and ZG-2 showed highest per cent fruit rot (19.5-32.0), while it was minimum (10 %) in Sanour-4.

Key words: Ber, rainfed, yield, TSS, acidity, ascorbic acid

Ber (*Zizyphus mauritiana* Lamk.) is one of the most ancient and India ranks first amongst the ber growing countries of the world. Owing to its good potential for high yield and excellent economic returns, ber is grown as a commercial crop in Jammu, Punjab, Haryana and Rajasthan (Gupta and Kaul, 2011). The total area under major horticultural crops in Jammu and Kashmir State is 3.07 lakh ha, of which ber fruit crop occupies 7,820 ha with an annual production of 16,330 metric tons (Anonymous, 2009). Ber fruits are very nutritious and rich in vitamin C, A and B complex. Ber fruits can be within the reach of the poor people and hence known as poor man's fruit. Among the fruit trees, ber cultivation requires perhaps the least inputs and care. It is a crop of semi-arid and arid regions. There are quite a good number of cultivars which are liked by the different people. As yet no serious attempt has been made to classify these cultivars on the basis of physico-chemical characteristics and resistance to storage diseases (Pareek, 1983). In addition to this, a cultivar should possess good blend of TSS, acidity, hard flesh, good flavour and aroma besides resistance/tolerance to diseases especially storage (Kaushik *et al.*, 2004). The present paper describes the fruit characters of five ber varieties so as to find the most suitable one for rainfed conditions of Jammu.

Materials and Methods

Eighteen years old ber trees of five cultivars planted at 5 m x 5 m spacing in the experimental orchard of Rainfed Research Sub-Station for Sub-Tropical Fruits, Raya, SKUAST-Jammu were

undertaken for investigation. The five cultivars taken for this investigation were Ranjari Selection 1, Ranjari Selection 2, Raya Selection, Sanour 4 and ZG 2. More than 50 percent fruits changed colour was considered as the time of ripening. For other fruit characters fifty representative ripe fruits were picked at random from each tree at the time of harvesting during the months of March-April in the years 2010 and 2011 and different observations were recorded on physical (shape, colour of ripe fruit, fruit weight, fruit length, fruit diameter and yield) and quality (pulp-stone ratio, total soluble solids, acidity and ascorbic acid) characteristics of ber. Completely randomized block design was used for chemical analysis purpose and fruit-rot incidence in storage with four replications. Fruit weight was measured by using digital balance (Indosaw-805CH). Fruit length and fruit diameter was determined by digital Vernier Calliper (Mitutoyo) whereas, fruit yield data were recorded at the time of each picking. Total Soluble Solids (TSS) was estimated with the help of hand refractrometer. Titratable acidity and ascorbic acid was determined by using the standard procedures of Ranganna (1986). The data obtained was statistically analysed (Gomez and Gomez, 1984). Fruit rot incidence was recorded at 0, 1, 2, 3 and 4 days after storage by counting the infected and healthy fruits of each cultivar and converted into percent fruit rot incidence by using the following formula:

$$\text{Percent fruit rot incidence} = \frac{\text{No. of infected fruits}}{\text{Total no. of fruits observed}} \times 100$$

However, the fungus was identified through microscopic examination.

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Results and Discussion

Physical characters

The fruits of all cultivars differed in their ripening time. Fruits of cv. ZG 2 experienced earliest maturity (1st-3rd week of March), while Ranjari Selection 1 was last to mature (4th week of March-2nd week of

April), and fruits of cvs. Ranjari Selection 2, Raya Selection and Sanour 4 matured during 2nd-3rd week of March to 1st week of April. The shape of fruit was oval in all the cultivars under study. The colour of fruits at maturity was golden yellow in Sanour 4 and yellowish green in Raya Selection. However, rest of the cultivars showed greenish yellow colour (Table 1).

Table 1. Physical characters and fruit yield of different ber cultivars

Cultivars	Ripening time	Shape of fruit	Colour of ripe fruit	Fruit weight (g)			Fruit size						Yield (Kg tree ⁻¹)		
							Fruit length (cm)			Fruit diameter (cm)					
				2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
Ranjari Selection 1	4 th week of March 2 nd week of April	Oval	Greenish yellow	16.2	18.4	17.3	3.40	3.85	3.6	1.76	1.95	1.86	86	91	88.5
Ranjari Selection 2	3 rd week of March 1 st week of April	Oval	Greenish yellow	14.7	16.6	15.7	4.75	5.25	5.0	3.18	3.38	3.28	78	83	80.5
Raya Selection	3 rd week of March 1 st week of April	Oval	Yellowish green	10.6	12.4	11.5	2.25	2.53	2.39	4.72	4.98	4.85	70	76	73
Sanour 4	2 nd fortnight of March	Oval	Golden yellow	20.0	22.3	21.2	4.15	4.53	4.34	2.53	2.75	2.64	96	102	9
ZG 2	1 st -3 rd week of March	Oval	Greenish yellow	8.3	9.2	8.8	2.65	3.04	2.80	2.07	2.28	2.18	61	65	63
CD5%				6.0	6.8	—	1.54	1.66	—	1.03	1.11	—	15.9	16.8	—
Mean				13.9	15.8	14.9	3.44	3.84	3.62	2.85	3.07	2.96	78.2	83.4	80.8
Range				8.3-	9.2-	8.8-	2.25-	3.04-	2.8-	1.76-	1.95-	1.86-	61-96	65-102	63-
				20.0	22.3	21.2	4.75	5.25	5.0	4.72	4.98	4.85			99
SE (M)				1.9	2.3	—	0.51	0.54	—	0.34	0.37	—	5.25	5.36	—

The statistically highest value of fruit length (4.75 cm and 5.25 cm) was observed in Ranjari Selection 2, followed by comparable values (4.15 and 4.53 cm) in cv. Sanour 4 during the years 2010 and 2011, respectively. The variety Raya Selection registered highest fruit diameter (4.72 cm and 4.98 cm), followed by (3.18 cm and 3.38 cm) in Ranjari Selection 2 during both the years. However,

minimum fruit length (2.25 cm and 2.53 cm) and diameter (1.76 cm and 1.95 cm) was recorded in Raya Selection and Ranjari Selection 1, in years 2010 and 2011, respectively (Table 1).

Average yield tree⁻¹ varied significantly in different cultivars. Maximum fruit yield (99 kg tree⁻¹) was registered in Sanour 4, which was followed by Ranjari Selection 1 (88.5 kg tree⁻¹) whereas,

Table 2. Quality characteristics of different cultivars of Ber

Cultivars	Pulp/stone ratio			TSS (%)		Acidity (%)			Ascorbic acid (mg 100 g ⁻¹)			
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
Ranjari Selection 1	14.6	12.4	13.5	26.3	24.6	25.5	0.77	0.70	0.74	75.3	80.4	77.9
Ranjari Selection 2	21.1	22.3	21.7	20.4	21.3	20.9	0.33	0.24	0.29	57.6	65.2	60.2
Raya Selection	19.8	18.7	19.3	15.8	13.8	14.8	0.26	0.28	0.27	123.8	122.8	123.3
Sanour 4	17.2	15.6	16.4	20.1	18.0	19.1	0.43	0.38	0.41	88.2	93.7	90.9
ZG 2	10.1	9.9	10.0	13.9	12.0	12.9	0.50	0.42	0.46	103.4	111.2	107.3
CD5%	6.55	6.23	—	8.23	7.75	—	0.21	0.14	—	34.3	36.4	—
Mean	16.6	15.8	16.2	19.3	17.9	18.6	0.46	0.40	0.43	89.7	94.7	97.2
Range	10.1-	9.9-22.3	10.0-	13.9-	12.0-	12.9-	0.26-	0.24-	0.27-	57.6-	65.2-	90.2-
	21.1		21.7	20.4	24.6	25.5	0.77	0.70	0.74	123.8	122.8	123.3
SE (M)	2.15	2.04	—	2.71	2.55	—	0.07	0.05	—	11.29	11.90	—

minimum average fruit yield (63 kg tree⁻¹) was recorded in ZG 2 (Table 1).

Quality characters

Higher pulp to stone ratio is considered to be a desirable character for ber quality. Statistically

highest pulp stone ratio (21.7) was observed in Ranjari Selection 2, followed by comparable value 19.3 recorded in Raya Selection whereas, minimum value of pulp stone ratio (10.0) was observed in ZG 2 (Table 2). Inconsistency in pulp stone ratio in ber varieties was also reported by Kaushik *et al.*, (2004).

Total Soluble Solids (TSS) of all varieties varied between 12.9-25.5 percent however, highest mean value of TSS (25.5 %) was noticed in Ranjari Selection 1 and minimum mean value (12.9 %) in variety ZG 2 during both the years. However, values of TSS obtained with varieties Ranjari Selection 2, Raya Selection and Sanour 4 were statistically at par during both the years under study (Table 2). The acidity in fruit pulp varied between 0.26-0.77 per cent in 2010 and 0.24-0.70 percent in 2011 with the mean minimum value (0.27 %) in Raya Selection and mean maximum value (0.74

%) being in Ranjari Selection. Dass *et al.*, (1992) also reported a wide range of variability in TSS and acidity among different cultivars of ber.

The fruits of Raya selection recorded the highest quantity of ascorbic acid to the tune of 123.3 mg 100 g⁻¹ of fruit pulp (Table 2). Varieties like ZG 2 (107.3 mg 100 g⁻¹), Sanour 4 (90.9 mg 100 g⁻¹) and Ranjari Selection 2 (90.2 mg 100 g⁻¹) also contained higher amount of ascorbic acid. However, it was recorded minimum in Ranjari Selection 1 (77.9 mg 100 g⁻¹).

Table 3. Fruit rot incidence in different cultivars of Ber at different days of storage

Cultivars	Fruit rot incidence (%)														
	0 day			1 day			2 days			3 days			4 days		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
Ranjari Selection 1	3.0	2.0	2.5	8.0	6.0	7.0	14.0	11.6	12.8	17.5	14.5	16.0	21.0	18.0	19.5
Ranjari Selection 2	5.0	3.0	4.0	10.0	7.5	8.8	16.5	13.6	15.1	19.0	16.5	17.8	24.5	21.5	23.0
Raya Selection	8.0	6.0	7.0	11.0	9.5	9.8	17.5	14.0	15.8	20.0	17.0	18.5	26.5	24.0	25.3
Sanour 4	1.0	0.5	0.75	4.0	2.5	3.3	8.0	6.0	7.0	11.0	9.0	10.0	11.0	9.0	10.0
ZG 2	7.0	6.0	6.5	13.0	10.5	11.8	21.0	18.6	19.8	23.5	21.5	22.5	33.0	31.0	32.0
CD5%	3.21	2.26	—	4.61	3.73	—	6.12	5.28	—	6.51	4.37	—	6.19	6.79	—
Mean	4.8	3.5	4.15	9.2	7.2	8.1	15.4	12.8	14.1	18.2	15.7	16.9	23.2	20.7	21.9
Range	1.0-8.0	0.5-6.0	0.75-7.0	4.0-13.0	2.5-10.5	3.3-11.8	8.0-21.0	6.0-18.6	7.0-19.8	11.0-23.5	9.0-21.5	10.0-22.5	11.0-33.0	9.0-31.0	10.0-32.0
SE (M)	1.06	0.74	—	1.52	1.23	—	2.01	1.74	—	2.14	1.44	—	2.02	2.23	—

Fruit Rot incidence

All the studied ber varieties viz., Ranjari Selection 1, Ranjari Selection 2, Raya Selection, Sanour 4 and ZG 2 were infected with fruit rot. *Cladosporium tenussimum* Coobe, *Pythium aphanidermatum* and *Phoma nebulosa* were fungal pathogens identified as a cause of fruit rot during storage under rainfed area of Jammu. The minimum fruit rot incidence was found in cv Sanour 4 at different storage days viz., 0.75, 3.3, 7.0, 10.0 and 10.0 percent at 0, 1, 2, 3 and 4 days of storage. It was immediately followed by Ranjari Selection 1 viz., 2.5, 7.0 and 19.5 percent at 0, 1 and 4 days of storage.

However, maximum fruit rot incidence was recorded in cultivar ZG 2 at all the storage days under study. These findings are in line with Sharma *et al.*, (1993). They also identified *Tenussium coobe*, *Fusarium pallidroseum* (Coobe) Sacc., *P. aphanidermatum*, *Phoma nebulosa* and *Rhizoctonia solani* as a cause of fruit rot during storage.

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