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## Physico-chemical properties of fresh aonla fruits dropped at different stages of growth and development cv. NA-10, NA-7, Chakaiya and Krishna

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### Abstract

The present investigation on aonla was conducted in Randomized Block Design (RBD) with four treatments, replicated thrice, considering one plant as a unit. The observations were recorded for physico-chemical characters of dropped aonla fruits in fresh condition. The maximum fruit length was observed in Krishna followed by NA-10 at the end of the maturity. Fruit diameter was recorded maximum in NA-10 followed by Krishna during the later stages of growth. Variety NA-10 had fruits with maximum fruit weight followed by Krishna in the later stages of growth. Maximum crude fibre percent was reported in variety NA-10 followed by Chakaiya in the advance stages of maturity. Fruits of variety Chakaiya were found to have maximum TSS percent followed by Krishna. Maximum acidity in the fruits was reported in Krishna at 90 days from the pea stage followed by Chakaiya. The acidity gradually increases up to 90 days from pea stage and later on decreases. Ascorbic acid content increases till the end of harvesting and maximum ascorbic acid was found in cultivar Krishna. Variety NA-10 reported highest dry weight and minimum moisture content followed by Krishna and Chakaiya in the advance stage of maturity, respectively.

**Keywords:** Physico-chemical, TSS, acidity, ascorbic acid, organoleptic, etc

### 1. Introduction

Aonla (*Emblica officinalis*) is commonly named as 'Indian gooseberry'. Aonla fruits are fleshy, yellowish green in colour having six vague perpendicular furrows enclosing seeds. The fruit is a very rich source of vitamin C. Every 100g of fresh fruit provides 470 – 680 mg of vitamin C. Banarasi, Chakaiya, Krishna, Francis (Hathijhool), Kanchan (NA-4), NA-6, NA-7, Anand-1, 2, 3 are some of the commercially cultivated varieties of aonla in India. Owing to its excellent nutritional profile and physico-chemical properties, aonla is processed into different types of product. Aonla fruit having sour and astringent taste, generally utilized raw, cooked or in the form of pickle. Preserves, juice, jam, cheese, candy, powder, beverage, laddoo, burfee, chutney are the different types of aonla products available in the market and preferred by the consumer being the rich source of vitamin C and antioxidants. Aonla is one of the main constituent of many Ayurvedic preparations like Triphla and Chyawanprash. Aonla fruits have unexplored various nutritional as well as medicinal properties at different stages of development. Since aonla fruits starts dropping right from the pea size stage to harvesting stage. Works are not yet done considering the nutritional value at different stages of aonla dropped and also the farmers are forced to mix the aonla fruits of every stage together for marketing of the dropped aonla therefore there is need to analyze dropped aonla fruit at different stages so that dropped aonla fruits can be utilized for value added products and growers can fetch better price while selling their dropped aonla in fresh or dried form to their particular industries.

### Method and Material

#### Sample Collection

The samples were collected from 22 years old aonla orchard planted under sodic soil condition and site is located at the Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. This site is located in typical saline-alkaline belt of indigenous plains of eastern Uttar Pradesh. From the orchard four varieties viz. NA-10, NA-7, Chakaiya and Krishna were selected for collection of samples. Samples were collected at every 15 days interval from the pea stage of development till the harvest.

### Physical Character Analysis

Ten fresh or one day before dropped fruits in the quantity of 3kg were selected at each date of observations randomly. The size of the fruit was measured by the Vernier Callipers. Weight of fruit was recorded using an electronic balance. The moisture content (%) was calculated by subtracting the dry weight along with the weight of seeds from the fresh weight and expressed as the percent of fresh weight. The fibre extracted is weighed on the electronic chemical balance and recorded. The colour of the fruits was observed visually on each date of the observation for all the cultivars.

### Chemical characters of the fruits

Ten fruits were selected randomly among the dropped fruits and estimations were done in laboratory. T.S.S. was recorded using Hand Refractometer of each cultivar. Titrable acidity was calculated by titration against 0.1 N sodium hydroxide (NaOH) solution using phenolphthalein indicator. Ascorbic acid content was calculated by titrating against 2, 6-dichlorophenol indophenol dye solution. Total phenol was extracted in the dropped aonla fruits by following the procedure of Rana and Gupta with 80% boiling ethanol and estimated using Folin- Denis reagent calorimetrically. The organoleptic evaluation for assessing the colour, flavour and texture of the aonla fruits were conducted by a semi trained panel of nine judges, who scored on the following 9.0 point Hedonic Rating Scale for organoleptic acceptability of the fruit.

### Result and Discussion

#### Physical Characters

Among the physical characters, the fruit length results indicated that there was continuous increase in fruit length till the harvesting (Table 1). The maximum fruit length was observed in variety Krishna followed by NA-10 whereas the fruit smallest in length was of Chakaiya followed by NA-7. NA-10 variety was the fastest growing variety among all. Initial accelerated increase in fruit weight may be due to more biogenesis of natural occurring growth substances like auxins, gibberellins, cytokinin and others. Fruit diameter was also the increasing with the growth of fruits (Table 2). The maximum fruit diameter was observed in variety NA-10 followed by Krishna. The smallest diameter was noted in Chakaiya. Another parameter which was analysed was the fruit weight in which the continuous and gradual increase was seen (Table 3). The heaviest among all varieties was NA-10 followed by Krishna. The lightest fruit weight among all was noted in Chakaiya. Killadi *et al.* (2015) [1] reported that maximum fruit weight (26.11g) was attained by NA-10 followed by Krishna (25.16g) and NA-7 (24.10g). It was minimum 23.18g in Chakaiya.

Considerable fruit fibre content was found in later stages of fruit growth (Table 4). Initially there was no or very trace amount of fruit fibre was observed. The most fibrous variety was NA-10 followed by Chakaiya. The least fibrous fruits were of NA-7 variety. NA-6 recorded the lowest percentage of fibre content, whereas Chakaiya has the highest

**Table 1:** Fruit length (cm) of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	0.81	0.77	0.73	0.79	0.77
30	1.53	0.96	0.91	1.47	1.22
45	2.56	1.18	1.12	2.68	1.88
60	3.31	2.48	2.44	3.47	2.92
75	3.77	3.38	3.32	3.71	3.54
90	4.05	3.91	3.89	4.19	4.01
105	4.26	4.06	4.01	4.38	4.18
120	4.45	4.16	4.10	4.46	4.29
135	4.51	4.20	4.16	4.51	4.34
150	4.53	4.23	4.21	4.54	4.38
165	4.54	4.24	4.22	4.56	4.39
180	4.54	4.25	4.23	4.57	4.40
AV	3.57	3.15	3.11	3.61	
	Varieties (V)		Time period (A)		V X A
SEm±	0.05		0.07		0.16
C.D. at 5%	0.14		0.21		0.45

**Table 2:** Fruit diameter (cm) of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	0.76	0.72	0.68	0.73	0.72
30	1.48	0.90	0.87	1.42	1.17
45	2.51	1.12	1.06	2.61	1.82
60	3.27	2.43	2.38	3.42	2.87
75	3.73	3.32	3.33	3.67	3.51
90	3.99	3.85	3.82	4.13	3.95
105	4.20	4.01	3.96	4.33	4.12
120	4.41	4.11	4.05	4.39	4.24
135	4.46	4.17	4.11	4.46	4.30
150	4.49	4.19	4.16	4.48	4.33
165	4.52	4.19	4.17	4.50	4.34
180	4.52	4.21	4.18	4.51	4.35
AV	3.53	3.16	3.06	3.55	
	Varieties (V)		Time period (A)		V X A
SEm±	0.04		0.05		0.11
C.D. at 5%	0.10		0.14		0.31

**Table 3:** Fruit weight (g) of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	1.50	1.49	1.53	1.40	1.48
30	7.61	4.16	5.16	6.04	6.6
45	31.76	8.94	13.05	11.02	21.9
60	47.02	30.28	26.03	33.89	34.3
75	53.02	45.30	35.29	47.75	45.34
90	53.21	49.71	36.41	49.25	47.14
105	54.42	53.36	39.26	53.93	50.51
120	54.48	53.74	39.84	54.06	50.71
135	54.51	53.84	39.91	54.12	50.76
150	54.53	53.88	39.94	54.16	50.63
165	54.54	53.90	39.96	54.19	50.65
180	54.55	53.91	39.97	54.21	50.66
AV	43.49	43.49	29.87	39.85	
	Varieties (V)		Time period (A)		V X A
SEm±	0.61		0.88		1.94
C.D. at 5%	1.72		2.48		5.44

**Table 4:** Fibre content (%) of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	0.002	0.001	0.001	0.001	0.001
30	0.003	0.003	0.002	0.002	0.002
45	0.057	0.012	0.005	0.005	0.024
60	0.114	0.011	0.011	0.011	0.045
75	0.252	0.168	0.223	0.181	0.206
90	0.579	0.342	0.482	0.440	0.460
105	0.933	0.504	0.733	0.664	0.700
120	1.266	0.675	0.963	0.879	0.940
135	1.478	0.884	1.202	1.104	1.160
150	1.814	1.080	1.432	1.327	1.413
165	1.906	1.167	1.671	1.543	1.570
180	2.440	1.332	1.933	1.779	1.870
AV	0.903	0.514	0.721	0.661	
	Varieties (V)		Time period (A)		V X A
SEm±	0.02		0.03		0.06
C.D. at 5%	0.06		0.08		0.18

### Chemical Characters

Scrutiny of data indicated that the TSS of the varieties was increasing with the growth of fruits (Table 5). The highest TSS was recorded in Chakaiya variety followed by Krishna whereas the lowest TSS was recorded in NA-7 variety fruits. Reported that the TSS of aonla fruits varied widely depending on the variety and climatic conditions. Killadi *et al.* (2015) [1] reported on an average, highest TSS was noticed in Krishna (9.45%) followed by NA-10 (9.10%) and the lowest (7.76%) in NA-7. The increase in TSS with advance stage of growth may be due to conversion of polysaccharides into monosaccharides and simple sugars.

The aonla fruits have acidity in the form of citric acid. The data in table 6 depicts that the Titrable acidity of dropped aonla fruits was initially increased during the growth and there after decreased. The maximum acidity was recorded in Krishna variety followed by Chakaiya. Killadi *et al.* (2015) [1] reported, on an average, lower acidity was found in Chakaiya (1.28%) and highest (1.65%) in NA-10 followed by Krishna (1.47%) and NA-7 (1.41%). Initial increase in acidity might be due to higher synthesis of organic acids, it declined in advanced stages, which may be due to bioconversion of

organic acids to sugars. Variation in acidity in aonla fruits may be due to variation in agro-climatic conditions.

Ascorbic Acid, a Nutraceutical component of aonla also varied significantly by both cultivars and stages of growth (Table 7). Data indicated that Ascorbic Acid content increased consistently. The highest content was obtained in Krishna followed by Chakaiya. Highest amount (846.7mg/100g) was noted in Krishna followed by Chakaiya. The variation in Ascorbic Acid content may be associated with inherited characters of aonla cultivars. The higher ascorbic acid content might be attributed to the adequate supply of hexose sugars in photosynthetic activity. Variation in Ascorbic Acid among cultivars has also been reported by others (Kalra, 1988; Ghorai and Sethi 1996 [4, 3]).

### Organoleptic Quality

The organoleptic test of fresh dropped aonla fruits depicts that variety NA-7 was most accepted followed by Krishna in the last stage of harvest due to the low phenol content and less fibre content (Table 8)

**Table 5:** TSS (%) of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	1.99	1.73	1.70	2.16	1.90
30	2.35	2.05	2.13	2.55	2.27
45	2.95	2.52	2.69	3.06	2.80
60	4.68	4.17	4.43	4.75	4.51
75	6.24	5.68	6.06	6.34	6.08
90	7.22	6.64	7.12	7.33	7.08
105	7.91	7.36	7.94	8.08	7.82
120	8.26	7.70	8.40	8.48	8.21
135	8.48	7.92	9.02	8.76	8.54
150	8.67	8.09	9.25	8.95	8.74
165	8.71	8.12	9.29	8.99	8.78
180	8.74	8.14	9.32	9.02	8.80
AV	6.43	5.84	6.44	6.54	
	Varieties (V)		Time period (A)		V X A
SEm±	0.01		0.02		0.04
C.D. at 5%	0.04		0.05		0.11

**Table 6:** Acidity (%) of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	0.47	0.41	0.49	0.36	0.43
30	0.97	0.87	0.97	0.82	0.91
45	1.51	1.58	1.51	1.42	1.50
60	2.24	2.26	2.14	2.06	2.17
75	2.54	2.58	2.55	2.54	2.55
90	2.92	2.86	2.99	3.05	2.95
105	2.55	2.60	2.76	2.83	2.68
120	2.25	2.29	2.54	2.55	2.41
135	2.01	2.05	2.35	2.34	2.19
150	1.91	1.99	2.21	2.19	2.07
165	1.56	1.67	2.15	2.15	1.88
180	1.48	1.51	2.01	1.99	1.75
AV	1.87	1.90	2.05	2.02	
	Varieties (V)		Time period (A)		V X A
SEm±	0.01		0.01		0.03
C.D. at 5%	0.02		0.03		0.08

**Table 7:** Ascorbic acid (mg/100g) content of cultivars at different stages of aonla

Number of days	NA-10	NA-7	Chakaiya	Krishna	AV
15	10.30	9.30	10.30	12.00	10.47
30	20.00	19.30	19.70	25.70	21.75
45	95.00	91.30	95.30	101.70	95.82
60	166.00	165.70	175.00	177.70	171.10
75	221.30	220.30	229.70	241.30	228.15
90	275.60	263.30	293.70	300.70	283.32
105	382.30	352.00	414.00	435.70	396.00
120	484.00	451.30	532.30	568.70	509.07
135	607.00	542.30	667.30	701.00	629.40
150	728.70	633.30	810.30	844.00	754.32
165	730.30	635.70	810.70	845.70	755.60
180	731.70	642.70	811.00	846.70	758.02
AV	371.27	355.54	405.86	425.07	
	Varieties (V)		Time period (A)		V X A
SEm±	2.57		3.71		8.14
C.D. at 5%	7.22		10.43		22.85

**Table 8:** organoleptic quality of fresh aonla fruits

no. of days	na-10		na-7		chakaiya		krishna		hedonic rating
	overall average score	ranking	overall average score	ranking	overall average score	ranking	overall average score	ranking	
15	4.0	dislike slightly	3.5	dislike moderately	3.2	dislike moderately	3.3	dislike moderately	9 = like extremely
30	4.0	dislike slightly	3.8	dislike slightly	3.5	dislike moderately	3.6	dislike slightly	8 = like very much
45	4.5	neither like nor dislike	4.2	dislike slightly	3.9	dislike slightly	3.7	dislike slightly	7 = like moderately
60	4.8	neither like nor dislike	4.6	neither like nor dislike	4.4	dislike slightly	4.2	dislike slightly	6 = like slightly
75	5.2	neither like nor dislike	5.2	neither like nor dislike	5.1	neither like nor dislike	5.0	neither like nor dislike	5 = neither like nor dislike
90	5.4	neither like nor dislike	5.4	neither like nor dislike	5.4	neither like nor dislike	5.3	neither like nor dislike	4 = dislike slightly
105	5.6	like slightly	5.8	like slightly	5.7	like slightly	5.6	like slightly	3 = dislike moderately
120	6.0	like slightly	6.2	like slightly	6.0	like slightly	5.9	like slightly	2 = dislike very much
135	6.5	like slightly	6.7	like moderately	6.7	like moderately	6.6	like moderately	1 = dislike extremely
150	6.8	like moderately	7.4	like moderately	7.0	like moderately	6.9	like moderately	
165	7.2	like moderately	7.6	like very much	7.2	like moderately	7.2	like moderately	
180	7.3	like moderately	7.8	like very much	7.5	like moderately	7.4	like moderately	

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