

Nutritional variation at different ages of Roselle (*Hibiscus sabdariffa* L.) fruit

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Abstract

Rich in nutrients and medicinal properties, Rosella fruit is used in many countries around the world to make various processed products and beverages. *Hibiscus sabdariffa* commonly known as “Roselle” is a member of malvaceae family. It is a plant with a worldwide fame and has more than three hundred species which are distributed in tropical and subtropical regions around the world. This research was conducted during Kharif-2 season 2022 at BIRTAN regional Station, Barishal, Bangladesh in a randomized complete block design with three replications. Analyzed result indicated significant differences among the three ages fruits for most of the characters studied. Through this study, information on harvesting roselle fruit at the right age is available. Harvesting roselle fruit at the right age increases its nutritional and qualitative value. In this study, roselle fruits were collected at three ages of 15, 25 and 35 DAF respectively. Relatively less mature roselle is slightly higher in vitamin C but higher in other nutrients such as lycopene, Anthocyanin, β -carotene and Vitamins at 25 DAF. Rosella fruit yield and other traits related to yield were higher at 25 DAF than all other ages. Over mature 35 DAF Rosella fruits minerals contain higher. Therefore, it can be said that it is better to select roselle fruits calyces that are 25 days old for producing roselle drinks.

Keywords: Age, Calyce, DAF (Days after flowering) Fruit, Nutritional, Variation

INTRODUCTION:

Roselle (*Hibiscus sabdariffa* L.) is popularly recognized as ‘mesta’ or ‘chukur’ in Indian subcontinent including Bangladesh (Halimatul *et al.* 2007; Rao 2008). Roselle is locally known by different names in different countries (Ismail *et al.* 2008). It belongs to the family of Malvaceae which is originated from West Africa (Shoosh 1993) and commonly available in the tropics especially in the African countries (Abu-Tarboush *et al.* 1997). It is widely cultivated in Tropical Africa, Sudan, Egypt, Ethiopia, Mali, Nigeria, Chad, India, Indonesia, the Philippines, Malaysia, Brazil, Australia, Mexico, Hawaii and Florida of USA. The world largest producer is Thailand and China but the quality is the highest from Sudan (Food and Agriculture Organization). Roselle produced in Sudan fails to gain popularity due to its poor packaging and distribution. But in Sudan, it is a major crop of export. Roselle is an annual plant which requires around six months to complete its production cycle. Roselle is a miracle plant with various utilizations (Crane

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1949). The leaves and calyx are used as vegetable in many countries of the tropics. There are three different color groups: green, red, dark red are available in the tropics (Purseglove 1977). The calyx of red and dark red types are used to extract juice for fresh drink after sweetened and the leaves of green types are used as vegetables (Babalola 2000).

MATERIALS AND METHODS:

Experiment: A field experiment was conducted during 2021-2022 under rain fed in BIRTAN regional station Barishal, Bangladesh. The climate of the area is humid, tropical monsoon. The soil is clay loam with medium fertility. The experiment laid out in a Randomized Complete Block Design (RCBD) with four replications. The experimental unit was 4x3.6 meters. In each plot there were 6 rows of four meters length. The row 60 cm apart and within row according to the needed spacing. Sowing was done on 1th of August.

Growth attributes: A sample of ten plants was taken at random from each experimental unit to measure the following growth parameters: - Plant height (cm.): The height of the main stem from the ground level to the tip of the plant. -Number of branches/plant: Number of branches was determined by counting primary reproductive branches.

Phonological attributes:

Days to 50% flowering: Number of days from planting till 50% of the plants in the row bears at least one open flower. Days to 95% maturity: Time to 95% physiological maturity was taken as the number of days from planting till 95% of the plants in the rows became yellow, shed their lower leaves and the lowest capsules on the stem were about to split open. 2.4. Yield Attributes A destructive sample of five plants (uprooting) was taken at random from the five inner rows of experiment plot to measure the following attributes: -Number of calyxes/plant (at maturity). Calyxes yield per plant (g): The calyxes of five plants were peeled off from the capsules by using simple hand tools. The calyxes were dried under shade to constant weight. Then average calices yield per plant (g) was determined. Final calyxes yield (kg / ha).

Solvents used are Ethanol acidified with hydrochloric acid, citric acid and acid. Changes in anthocyanin, total phenols, water activity and total soluble solids are recorded at 15, 25 and 35 days after flowering. Anthocyanin was measured through recoding optical density of the filtrate at 535nm using spectrophotometer (Make: SYSTRONICS, Model: UV/VIS Spectrophotometer 117).

Statistical Analysis:

The collected data were analyzed for the estimation of the statistical parameters according to Gomez and Gomez (1984) procedure for a randomized complete block design. Mean separation: For comparison of means, Duncan Multiple Range Test (DMRT) was used at $P \geq 0.05$.

RESULT AND DISCUSSION

The results of plant height are shown in table 1. The non significant effect of crop density on mean plant height is observed in this study. The results of plant height are shown in table 1. The significant effect of crop age on mean plant height is observed in

this study. Maximum height was found 220 cm in 25 days after flowering. No. of fruit/plant 232 was highest in 35 days after flowering. Roselle fruit length, dia and 100 Fruits wt. was maximum in 25 days after flowering calyces.

Table-1: Morphological, yield and yield contributing characters of Roselle at different days after flowering:

Treatment	Plant height (cm)	No, of fruit/plant	Fruit length (cm)	Fruit dia(cm)	100 Fruits wt.(gm)
15 DAF	203	109	3.6	1.7	265.9
25 DAF	220	198	4.8	2.3	520.1
35 DAF	217	232	4.3	2.1	470.8
CV %	8.9	4.1	11.3	5.8	2.4
Level of significant	*	*	ns	*	**

The results of the nutritional composition of Hibiscus sabdariffa leaves and calyces given in the table 1 showed that the moisture content of the leaves is 12.50% while that of the calyces is 10.50%. The ash content revealed that the leaves have slightly higher ash (14.50%) than the calyces (11.67%). Higher ash content indicates the mineral content of substances. The variation in the ash content might be attributed to the type of vegetables used, soil variation and maturity level of vegetables. Crude lipid of the leaves (4.33%) is higher than the percentage crude lipid of the calyces (1.00%). From the analysis, the fibre content of the leaves was found to be 0.83% and that of calyces was 1.17%. Fibre is very important in diet, because it decreases serum cholesterol levels, risks of coronary heart diseases and hypertension. The crude protein found in this research were 5.37% for the leaves and 4.10% obtained from the calyces. Crude protein is a nutrient that the body needs. It also helps in the growth of the body and body maintenance. Table 2 shows the mineral composition of dried roselle leaves and calyces. It shows the presences of sodium, potassium, calcium, magnesium and phosphorus. Phosphorus was the most abundant mineral (5.00% and 5.48% for the leaves and calyces respectively). Phosphorus is essential for the development of teeth most especially in young children, it plays essential role for the formation and utilization of high-energy phosphate compounds (phosphagens). Phosphate is required for the formation of phospholipids, phosphoproteins and nucleic acids (DNA and RNA). [14] Calcium is a coordinator among inorganic elements, for example excess amount of Potassium, Magnesium or Sodium in the body can be corrected by Calcium and also adequate quantity of Calcium in the diet assist in Iron utilization. [15] Magnesium is an activator of many enzymes systems maintains the electrical potential in nerves. The mineral content of plants can be significantly influenced by variety, location, and environmental conditions [15].

Table 2 represented that Yield and yield contributing characters of Roselle calyces. Research consequence showed that 100 Fruits raw calyx wt. 341.3 gm in 25 days after flowering calyces and 100 Fruits dry calyx wt., Calyx dry & wet ratio was highest in 35 days after flowering calyces . The reason is that as the fruit of the roselle plant ages, the dry matter increases.

Table-2: Yield and yield contributing characters of Roselle calyces at different days after flowering

Treatment	100 Fruits raw calyx wt.(gm)	100 Fruits dry calyx wt.(gm)	Calyx dry & wet ratio
15 DAF	182.8	16.7	0.091
25 DAF	341.3	39.8	0.117
35 DAF	213.1	42.6	0.20
CV %	1.9	3.2	9.6
Level of significant	**	*	ns

The results of the nutritional composition of Hibiscus sabdariffa calyces given in the table 3 showed that the maximum moisture content of the calyces is 14.50% at 25 days after flowering while that of the is 9.03% lowest in 35 days after flowering. The ash content revealed that the 35 days after flowering calyces have slightly higher ash (10.30%) than the others days after flowering calyces. Higher ash content indicates the mineral content of substances. The variation in the ash content might be attributed to the type of used, soil variation and maturity level of calyces. Protein of the calyces at 35 DAF (1.47%) is higher than the others days after calyces. Protein is a nutrient that the body needs. It also helps in the growth of the body and body maintenance. From the analysis, the fiber content of the 35 days after (17%) was found highest. Fibre is very important in diet, because it decreases serum cholesterol levels, risks of coronary heart diseases and hypertension. Fat percentage was maximized at 25 days after flowering (2.93%). Result showed that the Carbohydrate (14.5%) was maximum at 25 days after flowering.

Table-3: Nutritional level of Roselle at different days after flowering

	Moisture(%)	Protein(%)	Fat(%)	Fiber(%)	Ash(%)	Carbohydrate(%)	Energy
15 DAF	11.7	0.9	1.81	8	4.6	6.4	35
25 DAF	14.5	1.34	2.93	14	7.1	11.7	58
35 DAF	9.03	1.47	2.74	17	10.3	14.5	71
CV %	6.2	14.2	12.1	4.4	5.3	5.1	3.4
Level of significant	*	ns	ns	**	*	*	**

Table 4 shows the vitamin C was highest at 15 days after flowering (19.14 mg/100g fresh) and lowest in 35 days after flowering. Amount of Lycopene 65.51µg/100g fresh was highest in 25 days after flowering. And the optimum amount of 41.8µg/100g fresh was achieved in 25 days after flowering calyces. Maximum amount of thiamine (0.15 mg/100g),Niacin (4.6mg/100g fresh) and Riboflavin(0.59mg/100g fresh)was fresh in 25 days after flowering calyces.

Table-4: Nutritional level of Roselle at different days after flowering

Treatment	Vitamin C (mg/100g fresh)	Lycopene (µg/100g fresh)	β-Carotene (µg/100g fresh)	Thiamine (mg/100g fresh)	Niacin (mg/100g fresh)	Riboflavin (mg/100g fresh)	Anthocyanin (mg 100 ml ⁻¹)
15 DAF	19.14	48.93	29.7	0.09	3.83	0.33	964.54
25 DAF	17.31	65.51	41.8	0.15	4.6	0.59	1423.21
35 DAF	14.73	42.96	34.32	0.11	3.96	0.41	1204.33
CV %	16.1	2.8	6.2	11.2	12.5	4.4	2.6
Level of significant	ns	**	*	ns	ns	*	**

Table 5 shows the mineral composition of fresh roselle calyces. It shows the presences of sodium, potassium, calcium, magnesium and phosphorus. Calcium was the most abundant mineral (19.2, 32.3 and 33.8 mg/100g fresh for the 15, 25 and 35 days after flowering calyces respectively). Phosphorus is essential for the development of teeth most especially in young children, it plays essential role for the formation and utilization of high-energy phosphate compounds (phosphagens). Phosphate is required for the formation of phospholipids, phosphor proteins and nucleic acids (DNA and RNA). (Mclean, K. Roselle, 1973) Calcium is a coordinator among inorganic elements, for example excess amount of Potassium, Magnesium or Sodium in the body can be corrected by Calcium and also adequate quantity of Calcium in the diet assist in Iron utilization. (Narayanan, A. and Narayan, V., 1987) Magnesium is an activator of many enzymes systems maintains the electrical potential in nerves. The mineral content of plants can be significantly influenced by days after flowering (Narayanan, A. and Narayan, V., 1987). Phosphorus, Iron and Magnesium contain higher in 35 days after flowering calyces than others.

Table-5: Nutritional level of Roselle at different days after flowering

	Calcium (mg/100g fresh)	Phosphorus (mg/100g fresh)	Iron(mg/100g fresh)	Magnesium (mg/100g fresh)
15 DAF	19.2	210.6	6.2	9.01
25 DAF	32.3	294.2	9.4	11.21
35 DAF	33.8	304.7	11.2	15.10
CV %	2.7	3.1	5.2	11.2
Level of significant	**	**	*	ns

CONCLUSION:

Under this research, information on harvesting roselle fruit at the right age is available. Harvesting roselle fruit at the right age increases its nutritional and qualitative value. In this study, roselle fruits were collected at three ages of 15, 25 and 35 DAF respectively. Relatively less mature roselle is slightly higher in vitamin C but higher in other nutrients such as lycopene, Anthocyanin, β -carotene and Vitamins at 25 DAF. Rosella fruit yield and other traits related to yield were higher at 25 DAF than all other ages. Over mature 35 DAF Rosella fruits minerals contain higher. Therefore, it can be said that it is better to select roselle fruits calyces that are 25 days old for producing roselle drinks.

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