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Nutrient composition of strawberry genotypes cultivated in a horticulture farm

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ABSTRACT

This article decribes the nutrient composition of four strawberry genotypes cultivated at the Sher-e-Bangla Agriculture University horticulture farm in Dhaka (Bangladesh). AOAC and standard validated methods were employed to analyse the nutrient composition. Protein, fat and ash contents were found to be vary significantly (LSD < 0.05), while the variation in moisture (LSD < 1.33), dietary fibre (LSD < 0.15) and total sugar (LSD < 0.09) were found to be insignificant among the genotypes. Vitamin C content ranged from 26.46 mg to 37.77 mg per 100 g edible strawberries (LSD < 0.060). Amount of carotenoids were found to be very low being in a range of 0.99–3.30 μg per 100 g edible fruit. Analysis of mineral revealed that strawberry genotypes contained a wide array of minerals including Ca, Mg, Na, K, P, Mn, Zn, Cu and Fe; most of which varied significantly (LSD < 0.05) among the genotypes. Strawberries could be a potential dietary supplement for vitamin C along with minerals, particularly for the children who do not like local fruits, but love to eat the colourful strawberries.

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1. Introduction

Strawberries are a nutritious fruit with putative health benefits, because of their rich content of nutrients, with unique colour, flavour and taste (Giampieri et al., 2012; Mahmood et al., 2012; Marinova & Ribarova, 2007). They are consumed widely fresh or in processed forms assorted with dairy products.

Fruits and vegetables are a potential source of vitamins and minerals, which are essential for human health. Many epidemiological studies support that a diet rich in fruits and vegetables is associated with a lower incidence of many chronic diseases, including diabetes, infections, cardiovascular and neurological disorders and cancers (Johnsen et al., 2003; Vauzour, Vafeiadou, Pendeiro, Corona, & Spenser, 2010). Strawberries are a natural source of micronutrients such as vitamin C, minerals, folates, and some important phytonutrients (Giampieri et al., 2012; Mahmood et al., 2012; Marinova & Ribarova, 2007).

Strawberries are the most popular berries in the world. There are over 20 species and 600 varieties of strawberries that vary in their colour, flavour, size and texture (Mondal, 2010). Nutrient composition of strawberries differs by cultivar and variety, cultivation technique and area, and climate as well as harvesting time and ripeness (Hakala, Lapveteläinen, Huopalathi, Kallio, & Tahvonen, 2003; Mahmood et al., 2012; Recamales, Medina, & Hernanz, 2007). Some varieties of strawberries are now cultivated in Bangladesh (BSS, 2014; Hossain, 2010). A few genotypes of strawberry were developed at the Sher-e-Bangla Agriculture University horticulture farms in Dhaka (Bangladesh) (Emdad, Baten, Hossan, & Hossain, 2013; Islam, Hossan, Ahsan, Mehraj, & Jamal Uddin, 2013). The present study reports the nutrient composition of four such strawberry genotypes.

2. Materials and methods

2.1. Reagents

The analytical grade acetone, petroleum ether, butylated hydroxytoluene (BHT), metaphosphoric acid, sulphuric acid, nitric acid and perchloric acid were procured from Merck (Darmstadt, Germany). Ascorbic acid, 2,4-di-nitrophenyl hydrazine, all trans-β-carotene and mineral standards were obtained from Sigma Chemical Co. (St. Louis, MO, USA).

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2.2. Materials

2.2.1. Genotype cultivation and characterisation

Four strawberry genotypes (Fragaria x ananassa) were developed and grown at the Sher-e-Bangla Agricultural University horticulture farm (Dhaka, Bangladesh) (23°48′N 90°24′E with an elevation of 8.2 m, http://www.worldatlas.com/aatlas/findlatlong.htm). The berries were collected for analysis of nutrient composition. The genotypes were characterised by growth and reproductive parameters, fruit structrures and morphological features (Emdad et al., 2013), which are summarised in Table 1. Specimens of each germplasms were collected from different nurseries.

The strawberries were gown in a randomized complete block design with three blocks (size-2 m × 1 m each) from November 2009 to March 2010. The blocks were exposed to sun for one week. Land was harrowed, ploughed and cross-ploughed three times, followed by laddering to obtain a good tilth. Cowdung, urea, TSP, MOP, zypsum and boron were applied at the rate of 10 tonnes, 150 kg, 120 kg, 150 kg, 10 kg and 3 kg per hector respectively. All the cowdung, TSP and half of MOP, zypsum and boron were applied at the time of land preparation. Urea and rest half of MOP were applied in two instalments at 30 and 50 days after planting. Seedlings were planted in such a way that the crown remained shallow. Irrigation, gap filling, weeding and top dressing were undertaken for better growth and development of the strawberry plants.

2.2.2. Sampling and processing

Strawberries were harvested at commercial ripeness (>75% of the surface showing red colour). Approximately 300 g fruit from each genotype were collected in triplicate, placed in autoseal polybags and were taken to the laboratory at the Institute of Nutrition and Food Science (University of Dhaka, BD). Fruits were washed with demineralized water, and after removing surface water, air dried. The sepals were dissected with a knife and mashed in a glass mortar with a pestle cleansed previously with demineralized water.

2.3. Analysis of proximate nutrients

Moisture content was determined by measuring the amount of water removed from the freshly processed fruit (5.0 g) following direct heating in an air oven at 100–105 °C until a constant weight was achieved (AOAC, 1998a).

Protein was estimated by determination of nitrogen content using the Micro-Kjeldahl method and calculated using the total nitrogen conversion factor 6.25 (AOAC, 1998b). Analysis of nitrogen content comprised digestion of dried strawberry samples (1.0 g) in an auto-digestor and distillation in an auto-distillation (Autometic digestion_distilation unit, VELP Scientifica srl, Usmate Velate (MB), Italy) before titration using a burette.

Fat. A Soxhlet extractor using petroleum ether was used to estimate total fat in the fruits (AOAC, 1998c).

Ash. An amount of 0.5 g dried strawberry powder was heated in a Muffle furnace (CARBOLITE, 1100 °C, Chamber Furnace, ELF models, England) at 600 °C for 3 h to determine a value for ash (AOAC, 1998d), which was calculated from the weight difference.

Dietary fibre was analysed using a total dietary fibre assay kit (TDF-100A, Sigma–Aldrich, Saint Louis, USA).

Carbohydrate in the strawberries was determined by difference (Raghuramulu, Madhavan, & Kalyanasundaram, 2003), where moisture, protein, fat, ash and dietary fibre contents were subtracted from the total weight of strawberry.

Total sugar was determined using the method of Lane and Eynon and Fehling's solution as described by AOAC (1998e).

2.4. Analysis of vitamin C

Vitamin C content was estimated using spectrophotometric method with 2,4-dintrophenylhydrazine as an indicator (AOAC, 1998f). Freshly processed fruit (1 g) was homogenised in a mortar with a pestle with metaphosphoric acid (5% metaphosphoric acid in 10% acetic acid solution in water), filtered and treated with 85% sulphuric acid solution and 2,4-dintrophenylhydrazine, and then incubated at 60 °C for 60 min in a water bath. Absorbance was measured at 520 nm in a spectrophotometer (UV-1601, UV–Visible, Shimadzu Corp. Japan) for estimation of vitamin C in the fruits.

2.5. Analysis of carotenoids

Total carotenoids content was determined, following acetone–petroleum-ether extraction, using a spectrophotometric method (Rodrizues-Amaya & Kimura, 2004). The carotenoids were extracted by *grinding* the processed fruit (2 g) in a mortar with a pestle and cold acetone. The mixture was passed through a sintered glass filter under vacuum, and the carotenoids were separated from the acetone using petroleum ether in a separating funnel. The petroleum eluent was adjusted to a specific volume with petroleum ether and absorbance was measured at 450 nm in a spectrophotometer (UV-1601, UV–Visible, Shimadzu, Tokyo, Japan). All-trans-β-carotene (Sigma Chemical Co., USA) was used as standard.

2.6. Analysis of minerals

Mineral concentrations in the strawberry genotype were analysed using an atomic absorption spectrophotometric method (Petersen, 2002). Dried fruit samples (0.5 g) were subjected to wet digestion with nitric acid and perchloric acid (2:1 ratio) in an auto-digestor (Autometic digestion_distillation unit, VELP Scientifica srl, Usmate Velate (MB), Italy) at 325 °C to release mineral from the fruit matrix. After appropriate dilution, samples were aspirated into an air-acetylene flame to burn the elements into atomic components, the absorbance of which were measured

Table 1
Characteristic of strawberry genotypes cultivated at the horticulture farm in Sher-e-Bangla Agriculture University.

Strawberry genotype	Growth parameters			Reproductive parameters						Fruit structure			
	Plant height (cm)	Leaf area (cm^2)	No. of runner $plant^{-1}$	Days to 1st flower budding	No. of buds $plant^{-1}$	Days to flower anthesis	No. of flowers $plant^{-1}$	Length of pedicel (cm)	No. of fruits $plant^{-1}$	Wt. of fruit (g)	Yield $plant^{-1}$ (g)	Days to harvesting
FA 01	37.07^{A}	66.77^{A}	38^{A}	51.33^{B}	27.00^{A}	60.67^{B}	25.33^{A}	1.93^{B}	24.00^{A}	63.20^{A}	330.00^{A}	111.33^{C}
FA 02	$32.9b^{C}$	47.43^{C}	22^{C}	58.67^{A}	22.67^{BC}	69.33^{A}	16.33^{B}	1.46^{B}	23.33^{AB}	62.00^{A}	318.00^{A}	127.00^{A}
FA 03	34.53^{AB}	56.07^{B}	12^{E}	52.33^{B}	26.00^{AB}	62.33^{B}	23.67^{A}	1.80^{B}	12.67^{C}	52.90^{B}	202.67^{B}	118.33^{C}
FA 06	35.00^{AB}	63.6^{AB}	27^{B}	52.00^{B}	26.33^{AB}	62.33^{B}	24.67^{A}	2.83^{A}	22.33^{AB}	60.40^{A}	308.33^{A}	119.67^{B}

All of the characteristics vary at significant level ($p > 0.05$).
Letters in superscript indicate about the statistical differences among the strawberry genotypes.

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