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Hawthorn (*Crataegus* spp.) fruit: some physical and chemical properties

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Abstract

The hawthorn (*Crataegus* spp.) fruits were analysed for some physical (dimensions, geometric mean diameter, sphericity, bulk density, fruit density, volume, terminal velocity, hardness and porosity) and chemical (moisture, crude protein, crude oil, crude energy, crude fiber, ash, pH, acidity, water- and alcohol soluble extract) properties. Mineral content of wild hawthorn growing in Turkey were determined by Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES). All materials contained high amounts of Ca, K, Mg, Na and P. These values were found as 3046.37 ppm, 13,531.96 ppm, 1502.55 ppm, 312.18 ppm, 1477.88 ppm and 431,307.29 ppm, respectively. The mean pulp and seeds weight, length, diameter, mass, volume, geometric mean diameter, sphericity and projected area were measured as 2.16 g, 0.87 g, 14.39 mm, 19.34 mm, 3.03 g, 3083.3 mm^3, 17.52 mm, 1.22 and 4.19 cm^2, respectively. The energy, protein, cellulose, oil, ash, acidity and water-soluble extract values of hawthorn fruits were established as 34.02 kcal/g, 2.48%, 4.67%, 0.87%, 2.28%, 1.98% and 32.31%, respectively. It is very important to evaluate the physical properties for the design of equipment used for harvesting, transportation, storage and processing of fresh fruits. Also, the information supplied on the chemical properties of the hawthorn fruit can be used in human nutrition.

Keywords: Hawthorn; *Crataegus* spp.; *Rosaceae*; Physical and chemical properties

1. Introduction

Hawthorn (*Crataegus* spp.), belonging to the Rosaceae family, consists of small trees and shrubs. Common names for hawthorns may include, mayblossom, quick thorn, whitethorn, haw hazels, gazels, halves, hagthorn, and bread and cheese tree. They are usually multi-branched 2–5 m shrubby trees that can reach a height of up to 10 m. The hawthorn tree prefers the forest margins of lower and warmer areas (Brown, 1995; Grieve, 1982; Wichtl, 1996). The fruits of our native hawthorns are also edible but, as most people who have tried them will testify, there are much nicer fruits around. The colour of the ripe fruit ranges from yellow, through green to red and on to dark purple. Most of the species ripen their fruit in early to mid autumn (Brown, 1995). Some Crataegus constituents are predicted to be good antioxidants. The flower and fruit constituents responsible for free radical scavenging activity are epicatechin, hyperoside and chlorogenic acid. They are also among the best antilipoperoxidants (Bahorun & Greiser, 1996; Bahorun & Trotin, 1994; Rakotoarison & Greissier, 1997). However, only a few are used for medicinal purposes. Traditionally, the fruits or the berries are used for their astringent properties in heavy menstrual bleeding and in diarrhoea. Both the flowers and berries act as diuretics and can be used to treat kidney problems and dropsy. Apart from their delicious flavour, hawthorn fruits have been shown to have a tonic effect on the heart. Fruits of our native species are often used in the treatment of

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Nomenclature

D	diameter of hawthorn (mm)	q	torque arm (cm) (10.5 cm)
D_g	geometric mean diameter (mm)	T_a	beginning value of the torque (N cm)
L	length of hawthorn (mm)	T_m	average value of the torque (N cm)
M	mass of hawthorn (g)	V	volume of hawthorn (mm^3)
m_c	moisture content (%) d.b.	V_t	terminal velocity (m/s)
ε	porosity of hawthorn (%)	W	sample weight (10 N)
P_a	projected area (cm^2)	ϕ	sphericity of hawthorn
ρ_b	bulk density (kg/m^3)	μ_s	static coefficient of friction
ρ_k	fruit density (kg/m^3)	μ_d	dynamic coefficient of friction

weak heart conditions, especially if this is accompanied by high blood pressure (Baytop, 1984; Grieve, 1982; Schussler & Holzl, 1995; Wichtl, 1996). Studies have confirmed the potential of hawthorn fruits as a good source of antioxidants constituents (Bahorun & Greiser, 1996; Bahorun & Trotin, 1994; Kery & Verzarne, 1977; Rakotoarison & Greissier, 1997). No work was made on the chemical and the physical properties of hawthorn fruits hitherto. Therefore, attempts were made in this study to determine the chemical composition and the physical properties of equipment used in plantation, harvesting, transportation, storage and processing of matured wild hawthorn fruits.

2. Material and methods

2.1. Material

Fresh wild hawthorn fruits were collected from hawthorn trees growing from Konya (Derbent) in Turkey in September 2003. The fruits were transported in polypropylene bags and held at room temperature. Fruits were cleaned by a combination of manual and mechanical means to get rid of all foreign matter and crushed and immature fruits. Moisture contents were immediately measured on arrival soon.

2.2. Methods

2.2.1. The physical properties

All physical properties of fruits were determined using ten repetitions at the natural moisture content of 64.26% d.b.

To determine the size of fruits, ten groups of samples consisting of 100 fruits were selected randomly. Ten fruits were taken from each group and their linear dimensions-diameter and length were measured. Linear dimensions were measured by a micrometer to an accuracy of 0.01 mm.

Projected area (P_a) of fruits was determined by using a digital camera (Canon A 200) and Sigma Scan Pro 5 program (Ayata, Yalçın, & Kirişçi, 1997; Trooien & Heermann, 1992). The mass (M) of fruits was measured by an electronic balance to an accuracy of 0.001 g.

The bulk density (ρ_b) was determined with a hectoliter tester which was calibrated in kg per hectoliter (Deshpande, Bal, & Ojha, 1993; Jain & Bal, 1997; Suthar & Das, 1996). The fruits were filled into a calibrated bucket from a height of about 15 cm and the excess buds were removed using a flat stick. The fruits were not compacted in any way.

The fruit volume (V) and its density (ρ_f), as a function of moisture content, were determined by using the liquid displacement method. Toluene (C_7H_8) was used instead of water because it is absorbed by the fruits to a lesser extent. Also, its surface tension is low, so that it fills even shallow dips in a fruit and its dissolution power is low (Mohsenin, 1970; Singh & Goswami, 1996; Sıtkei, 1976).

The porosity (ε) was determined by the following equation:

$$\varepsilon = 1 - \rho_b/\rho_f$$

in which ρ_b and ρ_f are the bulk density and the fruit density, respectively (Mohsenin, 1970; Thompson & Isaacs, 1967).

Hardness values of fruits were measured by applied forces. Hardness was determined with a Test Instrument of Biological Materials using the procedure described by Aydın and Öğüt (1991) (Fig. 1). The device, has three main components which are a stationary and moving platform, a driving unit (AC electric motor and electronic variator) and a data acquisition (Dynamometer, amplifier and XY recorder) system. Hardness force was measured by the data acquisition system. The fruit was placed on the moving bottom platform and was pressed against the stationary platform. The probe used in the experiment had a 1.20 mm diameter and was connected to the dynamometer. The experiment was conducted at a loading velocity at 50 mm/min.

The terminal velocities (V_t) of fruits were measured using an air column. For each test, a sample was dropped into an air stream from the top of the air column, up which air was blown to suspend the material