Pharmacognosy Magazine [Phcog Mag]
Vol 4, Issue 19, Jul-Sep, 2009 Page 183-188
(An Official Publication of Pharmacognosy Network Worldwide)
Received: 14 Feb, 2009
Modified: 18 Mar, 2009
Accepted: 5 Apr, 2009

PHCOG MAG.: Research Article

Black Table Olives from Northeastern Region of Turkey: The Composition and Nutritive Value

Sezai Ercisli

Department of Horticulture, Faculty of Agriculture, Ataturk University 25240 Erzurum-Turkey

Author for Correspondence: *sercisli@hotmail.com; Mobile no: 90 5356395607*

ABSTRACT

Six olive cultivars (Butko, Gorvela, Kara Sati, Kizil Sati, Kizil Butko and Otur) were investigated for the first time in terms of total phenolic content, oil percentage, fatty acid composition and antioxidant activity. Analysis was performed on the flesh part of the raw black olive fruits. The total phenolic content was estimated with the Folin—Ciocalteu assay and antioxidant activity with β-carotene linoleate model system. The fatty acid analysis was performed by gas chromatography. There were statistically important differences among olive cultivars in terms of all searched parameters. The fatty acid results showed that all cultivars characterized by high level of oleic acid (63.49–77.18%). The antioxidant activity and total phenolic content was the highest in cv. Kara Sati as 73.88% and 53.46 µg GAE/mg dry weight basis. The antioxidant activity was correlated with the amount of phenolics found in samples.

KEYWORDS: *Antioxidant activity, chemical composition, olives.*

INTRODUCTION

A large number of epidemiological studies provide convincing evidence of the beneficial role of fruits and vegetables in the diet for the maintenance of health and the prevention of degenerative diseases, indicating an association between diets rich in fresh fruits and vegetables and a decreased risk of cardiovascular disease and certain forms of cancer This protection has been attributed to the fact that these foods may provide an optimal mix of phytochemicals, such as antioxidants, fibre and other bioactive compounds (1).

The olive tree (*Olea europaea* L.) is one of the most important fruit trees in the Mediterranean countries. Their products, olive oil and also table olives, are important components of the Mediterranean diet and are largely consumed in the world. Lower risks of coronary heart disease as well as certain cancers (of breast and colon) are associated with this diet (2,3). The Mediterranean region is the major international olive-growing area, accounting for almost 95% of the worlds olive tree plantation. The biggest olive producer countries in Mediterranean region are Spain, Italy, Greece and Turkey (4). Although Turkey is the fourth country in the production of fresh olives, it is the second greatest producer in the world for table olives after Spain (4). In order of production amounts in Turkey, the black table olives is the largest then follows the green and kalamata type olives (5).

In Turkey, the commercial production of olive is an important economic activity, especially in Aegean, Mediterranean and Marmara regions. However, there is very special olive producing area in Northeastern Turkey, namely Coruh valley. This valley is considered marginal areas for conventional crops. The most important olive varieties cultivated in this area are Butko, Kara Sati, Kizil Sati, Kizil Butko, Gorvela and Otur.

Table olives are important sources of compounds with important biological properties. It is well-known that the decreased incidence of cardiovascular disease in the Mediterranean area has been partly attributed to the consumption of olive products (6). These nutritional and medicinal qualities could be related to the phenolic compounds, which are considered to be responsible for conferring specific organoleptic and antioxidant proprieties to the olive derivatives (7). The interest in olive polyphenols is due to the fact that they may play a role in human diet and health. These compounds act mainly as antioxidants and radical scavengers and could be used as sources of potentially safe natural antioxidants for the food industry (8). The phenolic compounds increase the shelf life and nutritional quality of olive oil as well (9).

The physical and chemical characteristics of Turkish oil cultivars mainly from Western part of the country were well documented (5,10–13). As far as we know, no reports exists on the phytochemical content of table olives grown in Coruh valley which is accepted one of the 35 world hotspots of biodiversity pointed out by The World Conservation Union as the western section of "Caucasus Ecosystem" (14). Herein, we intended to determine the some chemical composition of different raw table olive cultivars produced in Coruh valley. We also intended to correlate the phenolics levels with the antioxidant activity of the table olive extracts.

MATERIALS AND METHODS

Plant material

Black-ripe olives (*Olea europea* cvs. Butko, Gorvela, Kara Sati, Kizil Butko, Kizil Sati and Otur) about 2 kg for per cultivar were hand-picked randomly from different parts of olive trees in the same orchard that received the same cultural practices in the Zeytinlik (Sirya) village in Coruh valley in 2006. In this region the growers harvested olive fruits traditionally at black-ripe stages by hand. The sampled fruits (raw) were immediately transported to the laboratory in cooled polythene bags and sorted to obtain fruit of uniform size and color.

Sample preparation and extraction

Raw fruit samples divided into two groups and first groups of fruits used for determining of oil ratio. The other group was dried at 45 °C in an oven in laboratory and ground to a fine powder with a mortar and pestle and kept at room temperature prior to extraction. The dried samples were packed into new plastic bags and stored in a dessicator for a maximum of 3 days until antioxidant activity and total phenolic content analysis.The flesh part was dried at 45 °C in an oven in laboratory and ground to a fine powder with a mortar and pestle and kept at room temperature prior to extraction. The dried samples were packed into new plastic bags and stored in a dessicator for a maximum of 3 days until antioxidant activity, total phenolic and oil analysis. Dried samples weighing about 100 g was extracted in a soxhlet with methanol (MeOH) at 60 °C for 6 h. The extract was then filtered and concentrated in vacuo at 45 °C. Finally, the extracts were then lyophilized and kept in the dark at +4 °C until tested.

Oil and fatty acid analysis

Oil was extracted from the olive fruits according to standard methods described by AACC (15). Fatty acid methyl esters were prepared by trans-esterification using a methylant solution consisting of benzene, methanol and concentrated sulphuric acid (25:75:1, v/v/v). Gas chromatography (GC) of methyl esters was performed on Hewlett Packard GC apparatus (Model HP6890, Palo Alto, CA) equipped with a hydrogane flame ionization detector. Retention times and peak areas were automatically computed by the data processor Identification was accomplished by comparing the retention time of unknown methyl esters with those of known fatty acid methyl ester standards.

Total phenolic content and antioxidant activity

Total phenolics in the fruit extracts were determined with Folin—Ciocalteu reagent according to the method of Slinkard and Singleton (16) using gallic acid as a standard. Results were expressed as μg of gallic acid equivalent (GAE) per mg of dry weight. In β-Carotene—linoleic acid assay, antioxidant capacity of olive fruits is determined by measuring the inhibition of the volatile organic compounds and the conjugated diene hydroperoxides arising from linoleic acid oxidation (17). Antioxidant capacities of the samples were compared with those of BHA and the blank.

Statistical analysis

The experiment was a completely randomized design with four replications. Data were subjected to analysis of variance (ANOVA) and means were separated by Duncan multiple range test at $P<0.01$ significant level.

RESULTS AND DISCUSSION

Oil percentage and fatty acid content

The oil percentage and fatty acid content of olive cultivars are shown in Figure 1 and Table 1. Statistically significant differences, $p<0.01$ were recovered between the means

of the both oil percentage and fatty acid content among cultivars (Figure 1, Table 1). The cv. Kara Sati had the highest oil percentage (31.11%), whereas the cv. Gorvela had the lowest one (24.93%) (Figure 1). The oil percentage of olive cultivars grown in Turkey was reported between 16.71–43.50% (5,11,13). Our oil results were in accordance with these literature.

The major fatty acid in all cultivars was oleic acid, C18:1 (63.49–74.16%). The other major fatty acids were palmitic acid, C16:0 (9.98–15.80%) and linoleic acid, C18:2 (8.79–12.49%), respectively (Table 1). The stearic acid, C.18:0 (1.04–2.03%), palmitoleic acid, C16:1 (0.87–1.16%), linolenic acid, C18:3 (0.27–1.13%) and arachidic acid, 20:0 (0.39–0.78%) were found minor amount in olive fruit flesh (Table 1). The margaric acid, 17:0 and behenic acid, 22:0 were found as trace amount. The presence of three major fatty acids, oleic, palmitic and linoleic acid in fruit flesh of various olive cultivars has previously been reported [15]. Olive oil is rich in oleic acid (monounsaturated). The oleic acid content was found between 63.70–83.60 % in olive cultivars grown in different part of world (5,10,12,13,14,18,19). Our result on oleic acid content was in agreement with those results. All our samples were characterized by high amounts of unsaturated fatty acids as compared to saturated analogues (Table 1). Among the principal factors affecting the fatty acids composition the following are to be mentioned: latitude, climate, genetic factors (variety) and grade of ripeness of the harvested olives (20). We sampled the fruits from cultivars which grown same location. Therefore the variation on fatty acid content of cultivars could be explained genotypic effect regardless the environment.

Total phenolic content and antioxidant activity

Total phenolic content of six olive cultivars are shown in Figure 2. There were wide differences among olive cultivars in terms of total phenolic content ($p<0.01$).

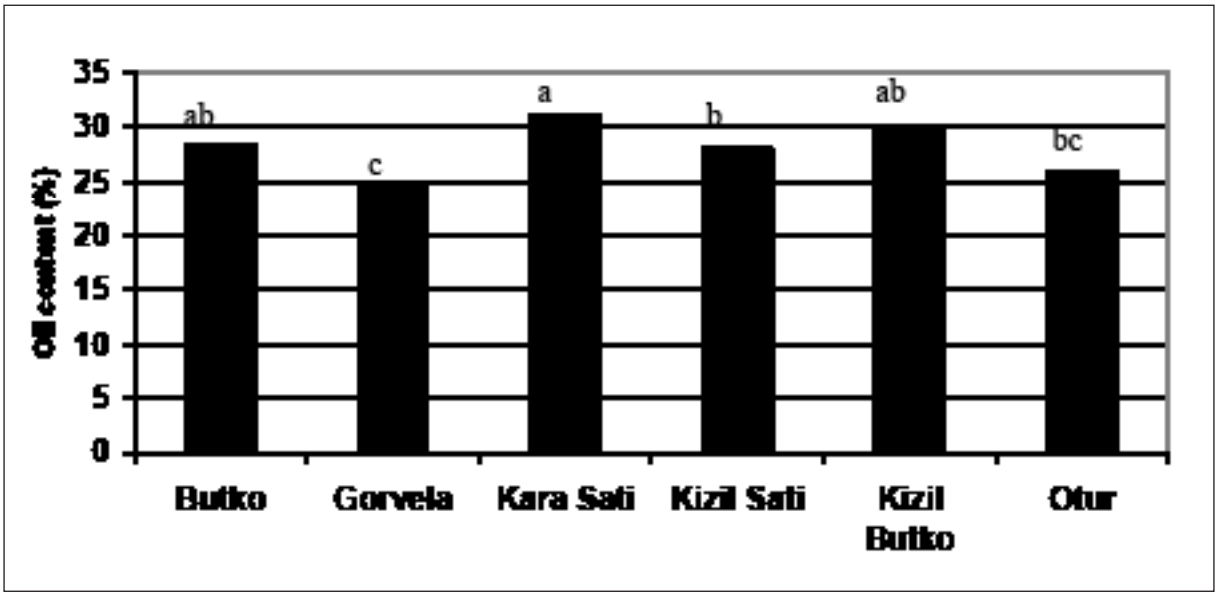

Figure 1: Oil content (%) of olive cultivars

Table 1: Fatty acid content of olive cultivars

FATTY ACID	BUTKO	GORVEL A	KARA SATI	KIZIL BUTKO	KIZIL SATI	OTUR
Palmitic (16:0)	15.08a	11.17ab	10.09ab	12.80ab	9.98b	14.45ab
Palmitoleic (16:1)	1.03^{NS}	1.12	0.93	0.87	1.16	0.96
Margaric (17:0)	trace	trace	trace	trace	trace	trace
Stearic (18:0)	1.23^{NS}	2.03	1.16	1.87	1.04	1.36
Oleic (18:1)	71.33ab	63.49b	77.18a	66.11ab	68.33ab	74.36ab
Linoleic (18:2)	11.17b	12.43ab	9.76bcc	9.83bc	12.49a	8.79c
Arachidic (20:0)	0.78^{NS}	0.39	0.47	0.43	0.61	0.47
Linolenic (18:3)	0.36^{NS}	0.44	0.21	0.27	0.32	1.13
Behenic (22:0)	trace	trace	trace	trace	trace	trace

Different letters (a–c) indicate the statistical difference within same rows at 1% Significant levels. NS: Not significants

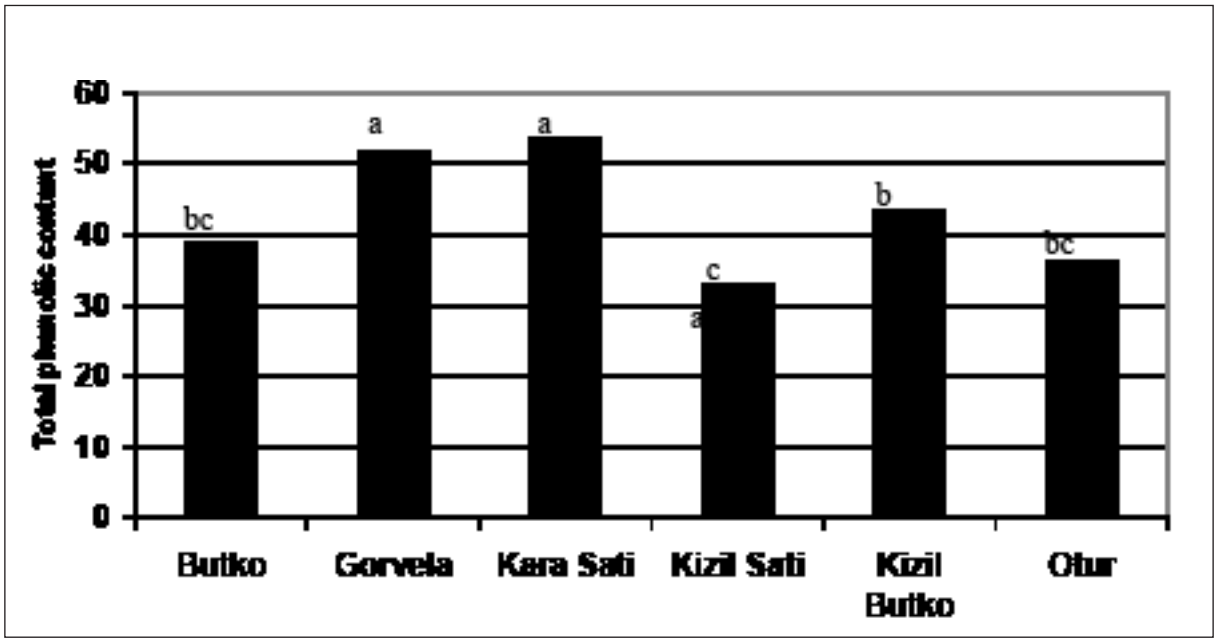

Figure 2: Total phenolic content (µg GAE/mg DW) of olive cultivars

The total phenolic content of the olive fruits (raw) per mg dry weight basis ranged from 33.30 µg GAE to 53.46 µg, following the order Kara Sati>Gorvela>Kizil Butko>Butko>Otur>Kizil Sati (Figure 2). Earlier, it was reported that there were wide variation among olive cultivars in terms of total phenolic contents (21,22,23). Our results can not be compared to above studies because table olives have a different qualitative and quantitative phenolic composition than the raw olive fruits from which they are prepared. The reason is the diffusion of phenols and other water soluble constituents from the olive fruit to the surrounding medium (water, brine or lye) and vice versa, the lye treatment and hydrolysis during fermentation. When Californian-type black olives are prepared, hydroxytyrosol and caffeic acid levels decrease markedly during the darkening process. Iron salts, used for colour fixation, catalyze the oxidation of hydroxytyrosol, which disappears (23). Previously, hydroxytyrosol was reported the most abundant identified phenolic compounds present in table olives (21,24,25). This compound results from the hydrolysis of oleuropein (26), which is the major phenolic in the fresh olive fruits (21,22). Oleuropein is responsible for the bitter taste of unprocessed olives and, to become edible, the fruits need to lose, at least partially, their natural bitterness. The phenolics content of olive depends on several factors, such as cultivar (22,24,27), climate (28), irrigation regimes (21), degree of ripeness of the fruit (29), and elaboration process (21). Recently there is an increasing interest in olive products and byproducts, due to their antioxidant properties. Many studies describe phenolic compounds as having a protective role in the oxidation of low-density lipoproteins (30) and in oxidative alterations due to free radical and other reactive species (31).

The antioxidant activity of table olive extracts measured by bleaching of β-carotene is presented in Figure 3. A statistical significant difference ($p<0.01$) was found among the samples and BHA. The results indicate a cultivar-dependent antioxidant activity with the cv. Kara Sati was the most active (73.88%) and lower for cv. Kizil Sati (57.20%) (Figure 3). However, the protection of β-carotene bleaching by the samples is lower than that of BHA standard (81.33%). These results agree with those previously reported for table olive fruits had high antioxidant capacity and antioxidant capacity of table olives strongly affected by cultivars (23,25). Antioxidants retard or inhibit the oxidation possibly by reactive radicals including ROS in a biological system. Olive may be good sources of natural antioxidants.

Total phenolic content and antioxidant activity of olives showed a linear relationship with a positive correlation coefficient of r^2=0.828 (data not shown). Previously it was showed a linear relationship between total phenolic content and antioxidant activity in table olives (9,32). The great difference among olive cultivars in terms of

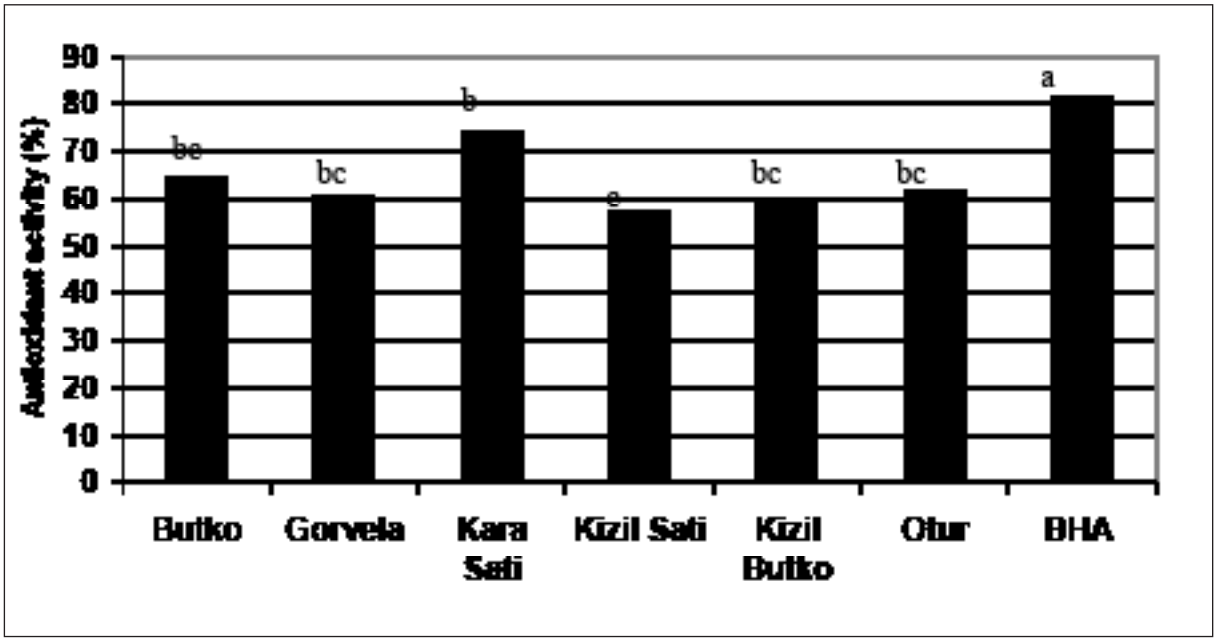

Figure 3: Antioxidant activity (%) of olive cultivars

total phenolics and antioxidant activity is supposed to be largely due to the cultivars because all plants were grown in the same ecological condition.

The results obtained in the present work denote that table olives may constitute a good source of healthy compounds, especially phenolics. This phenolic content of olives are of great interest, as they contribute to sensory characteristics and the long stability of olive oils and as they may be involved in biochemical and pharmacological effects, including anticarginogenic and antioxidant properties. Further studies of detailed phenolic composition of these cultivars are under investigation.

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