Research Paper

Effects of organic fertilizer and drying methods on total phenolic content and antioxidant capacity of organic white tea (*Camellia sinensis* O. Kuntze)

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ABSTRACT

The aim of this study was to determine the effect of different fertilizer doses and drying methods on total phenol content and antioxidant activity of organic white tea (*Camellia sinensis* L.) obtained from Hemşin Valley, the organic tea region of Rize/Turkey. The determination of phenolic constituents and antioxidant activity was done using the Folin-Ciocalteau and FRAP methods, respectively. The results showed that the phenolic content of white tea was as follows: 443.7 - 506.2 µg GAE/g DW in the drying oven, 421.4 - 473.6 µg GAE/g DW in shadow and 434.4 - 485.2 µg GAE/g DW in the lyophilizator. According to the FRAP method, the antioxidant activity was as follows: 1130.1 - 1176.9 mg FeSO₄/g DW in drying oven, 1141.2 - 1157.1 mg FeSO₄/g DW in shadow and 1005.3 - 1183.2 mg FeSO₄/g DW in lyophylizator. The results showed that different fertilizer doses and drying methods had important effects on the total phenolic content and antioxidant activity of white tea.

Key words: Different fertilizer doses, drying methods, phenol content, antioxidant activity, white tea.

INTRODUCTION

The tea plant in Turkey, as compared with the rest of the World, has a shorter adaptation, acceptance and cultivation history. However, the tea plant (*Camellia sinensis* L.) O. Kuntze has been accepted by the local farmers at he Black Sea Region rapidly beginning from the 1930s. Tea (*C. sinensis* var. *assamica* Kitamura) is probably the most widely consumed beverage in the world (Muktar and Ahmad, 2000) after water. On the World tropical and subtropical areas with adequate rainfalls, good drainage, and a slightly acidic soil are the suitable conditions where this plant can be grow best (Graham, 1999).

The common tea plant *C. sinensis* (L.) O. Kuntze is an evergreen shrub, there are several varieties of this species: one being the Indian Assam tea (*C. sinensis* var. *assamica* Kitamura) and the China-type (var. *sinensis*). Traditionally, tea is prepared from its dried young leaves and leaf buds, made into a beverage by steeping the leaves in boiling water. China is credited with introducing tea to the world, though the evergreen tea plant is in fact native to Southern China, North India, Myanmar and Cambodia (Hicks, 2001).

Tea contains a wide range of phenolic compounds. Its polyphenols include flavanols, flavandiols, flavonoids, and phenolic acids; these compounds may account for up to 30% of the dry weight of the tea leaves according to literature (Hilal and Engelhardt, 2007). Further, tea is one of the richest sources of antioxidants and the three major forms of antioxidant tea are green tea, oolong tea, and black tea. These teas are differing in their production methods and chemical composition (Balentine et al., 1997; Lambert and Elias, 2010).

Tea production are practised in the Eastern Black Sea Region, in a zone beginning from the Georgian border up to the Fatsa district in Ordu. In this region, tea production is mainly located in Rize, Ordu, Giresun, Trabzon and Artvin (Anonymous, 2016). As compared with other tea production areas in the World, these regions are rated as
high. In Asian countries like China, India and Sri Lanka, temperature does not fall to minus degree in tea production areas and tea production is covering the whole year. But in our country where we experience four climates, tea plantations are in fallow four six months. The fact that snow falls on Turkish tea plantations brings them an extra important characteristic. Because of this, character pesticides are not applied in our tea production areas. This gives Turkish tea as compared with teas in the rest of the World “the most natural tea” characteristic. Parallel to the developments regarding organic tea cultivation in the world, ÇAYKUR was initiated in 2003 studies to increase organic tea farming in our country. Within the context of organic tea farming, Borçka/Artvin and Çamlıhemşin and Hemşin/Rize were chosen as organic tea production areas.

Organic fertilizers in tea production

The objective of organic tea cultivation is to have an eco-friendly plantation; although amidst the conservation of ecology and natural habitat without polluting soil, air and water and yet maintaining sustainable tea production. In organic tea cultivation, tea is produced in the absence of synthesized chemicals, such as pesticides, fungicides, herbicides, growth regulators and concentrated fertilizers (Shamsul et al., 2017).

Ren et al. (1999) and Sun et al. (2003) reported that application of organic fertilizers is one of the important practical measures to improve soil fertility. In addition to providing necessary nutrients for crops and improving soil physico-chemical properties, organic fertilizer is able to enhance soil microbial activity of soil, such as improving activity of soil enzymes and increasing soil microbial biomass. Organic fertilizers have traditionally been used in agricultural areas, especially in view of their benefits for the soil biological and chemical properties (Queiroz et al., 2004). It is worth of note that the addition of organic residues is fundamental for carbon (C) recycling in the soil and can improve its physical quality (Brancalão and Moraes, 2008). Organic manures can be used as an alternative for the inorganic fertilizers. They release nutrients rather slowly and steadily over a longer period and also improve the soil fertility status by activating the soil microbial biomass (Ayuso et al., 1999). For decades, researchers have noted the benefits of manure additions to soil, from renovating eroded sites to improving soil physical properties and fertility following centuries of manuring (Latham, 1940).

White tea

White tea is made mainly from newly grown buds and young leaves with tiny, silvery hairs not exposed to sunlight to prevent chlorophyll production. Buds and leaves for white tea production are harvested only once a year in the early spring. Buds are plucked before they are open, then withered and air dried in the shade, under sunshine, or in a temperature-controlled room. White tea is the least processed type of tea. It is considered as a non-fermented type, however, a slight fermentation occurs since the processing lacks the step of enzyme deactivation (Kosinska and Andlauer, 2014). The tea takes its name from the silver fuzz that covers the buds which turn white after drying. Oxidation is completely avoided by ensuring there is no rolling and bruising (Owuor and Kwach, 2012).

Phenolic content in white tea (Camellia sinensis (L.) O. Kuntze)

White tea (WT), the least processed tea, is one of the less studied and is ascribed to have the highest content of phenolic compounds (Dias et al., 2003). White tea is composed of polyphenols, alkaloids, amino acids, carbohydrates, proteins, chlorophyll, volatile organic compounds, fluoride, aluminum, minerals and trace elements (Cabrera et al., 2003). White tea’s polyphenols include flavanols, flavandiols, flavonoids, and phenolic acids; these compounds may account for up to 30% of the dry weight of the tea leaves.

White tea, obtained from the same C. sinensis plant as black and green varieties, may have a lower TPC due to the fact that oxidation by polyphenol oxidase is prevented in white tea processing (Astorino et al., 2012). The total phenolic content of white tea was determined by Shannon et al. (2017) as 190.24 ± 7.73. Further, the extraction efficiency of different concentrations of aqueous ethanol, temperature and time for the extraction of total phenolics from white tea leaves was investigated using a central composite design. The total phenolic content in the white tea extracts ranged from 20.93 to 178.70 mg as GAE/g DW (Peiró et al., 2014).

Antioxidant activity of white tea (Camellia sinensis (L.) O. Kuntze)

Tea polyphenols have great medicinal and health benefits and they are potent source of antioxidants (Sharangi, 2009). In spite of numerous data about phenolic constituents, antioxidant activity and ameliorating effects of green and black tea on human health, little is known in this sense about white tea, which is the rarest and the least processed tea (Rusak et al., 2008). White tea is just made by drying only without any other normal fermentation process which is adopted for other tea varieties. The biochemical components such as flavonoids, total polyphenols, tannins and catechins are prominent in white tea. Catechin content...
is higher than tannin content. All those active components are higher in methanolic extracts than their corresponding aqueous extracts. The higher antioxidant activities are manifestations of all those active components (Saha et al., 2017).

Effect of different factors on tea quality have been conducted such as the analysis of chemical constituents of white tea of different qualities and different storage times (Ning et al., 2016), but studies on the effect of organic fertilizer and drying method together on phenolic content and antioxidant activity on white tea samples have not been conducted.

A tea plantation in the Apso setlement, located in the Hemşin valley, Rize was chosen as study area. Organic fertilizer was applied as 1000, 1500 and 2000 kg/ha as sole doses (March) when compared with the control (no organic fertilizer) application. The aim of this study was to determine the effect of organic fertilizer and different drying methods on yield, total phenolic content and antioxidant capacity in tea (C. sinensis (L.) O. Kuntze. As far we know it’s the first study in Turkey to investigate the effect of different drying methods and organic fertilizer applications on phenolic content and antioxidant activity of white tea (C. sinensis (L.) O. Kuntze.

**MATERIALS AND METHODS**

An organic fertilizer with pH= 8.2 and containing N-P-K at ratios of 7:2:6% respectively was used as sole doses (0, 5000, 1000, 1500 and 2000 kg/ha) in the present study. A tea plantation in the organic tea plantation area in Hemşin, Rize/Turkey was used as research area.

**Procedure**

A field trial according to randomized block design with three replication was conducted. Organic fertilizer doses were applied in March 2017. First shoot harvest was performed in May 2017, which was used for phenolic content and antioxidant activity analysis.

**Drying methods**

a. Drying oven: Fresh white tea samples were dried in a drying oven trademark Binder at 35°C for up to balanced dry weight.

b. Shadow: Fresh white tea samples were dried in shadow for up to balanced dry weight.

c. Lyophilizator: Lyophilizators are used to remove water from fast putrescent products to extend their validity life and to simplify their transportation. Lyophilization process is known as - freeze-drying is based on sublimation. The sample in chamber is freezeed and the pressure reduced, water from the sample is removed without disrupting the structure of the material. Fresh white tea samples were dried for 3-4 h at -80°C de in a lyophilizator trademark Labomar up to balanced dry weight.

**Statistical analysis**

Analysis of variance (ANOVA) was used to assess the influence of different drying methods and organic fertilizer doses on the phenolic content and the antioxidant activity of tea samples obtained from the present research conducted in the Apso settlement, Pazar/Rize, Turkey. All analyses were conducted with SPSS 20.0 and the F ratio was considered significant at P = 0.05 and high significant at P = 0.01. Graphics were created using Excel 2016.

**Determination of total phenolic content**

The total phenolic content of collected samples were determined using UV-Vis spectrophotometer as mg GAE/gr DW. The pretreatment of samples was the same as described in the FRAP method. Gallic acid was used as standard, according to the method described by the International Organization for Standardization (ISO) 14502-1. Sample extract as 1/10 of the total volume and 300 μl Na₂CO₃ was added to tubes containing water involving Folin reagent and all tubes were kept waiting in a ultrasonic shaker (50°C) for 15 min. The measurements done using a UV spectrophotometer device at a wave length of 765 nm to obtain the absorbance values.

**Determination of antioxidant activity**

A modified version of the FRAP assay described by Izzreen and Fadezelly (2013) was used to determine the antioxidant activity of collected samples as mg FeSO₄/gr DW.

For the determination of antioxidant content of the samples as pretreatment, 0.1 g of each dried sample was completed with methanol (80 %) to reach 10 ml volume. Samples were mixed first in the water bath (50°C) for a duration of 20 min and and the samples were keep waiting after this procedure for 1 h in the dark. The mixture was centrifuged after that for a 20 min, 4000 cycle/min process for obtaining the extracts, which are used for the determination of phenolic content and antioxidant activity of the investigated samples.

Collected samples were analyzed regarding their antioxidant activity values. White tea leaves were dried in the drying oven at 40°C and its antioxidant activity was determined using the UV-spectrophotometer by the FRAP
method. The determination of antioxidant capacity of investigated samples (pretreatments completed) was done using the FRAP method. The FRAP method based on the colorisation after the degradation of the Fe$^{3+}$ ion, bounded to TPTZ in an acid environment, to Fe$^{2+}$. 300 mM acetate buffer (pH 3.6), 10 mM 2,4,6-tripyridyl-s-triazine (TPTZ) and 20 mM FeCl$_2$.6H$_2$O solutions were mixed at a proportion of 10:1:1 as FRAP (ferric reducing / antioxidant power) reactives to obtain a buffer solution. A FeSO$_4$.H$_2$O solution was used to prepare different standart probes to obtain a calibration curve. The final samples were obtained with a mix of 1980 μl FRAP dispersive + 20 μl sample and kept waiting after that for 3 min n a ultrasonic shaker (50°C). The measurements were done using a UV Spectrophotometer device at a wave length of 595 nm to obtain the final absorbance values.

**RESULTS AND DISCUSSION**

To the best of our knowledge, there no research about the effect of organic fertilizer and drying methods on the phenolic content and antioxidant activity of white tea. For the chemical composition of tea, it can be said that it is complex and includes polyphenols, alkaloids (caffeine, theophylline and theobromine), amino acids, carbohydrates, proteins, chlorophyll, volatile compounds, minerals, trace elements and other unidentified compounds. Among these substances, polyphenols constitutes are the most interesting group and the main bioactive molecules in tea (Cabrera et al., 2003). The major polyphenolic compounds in tea are the flavan-3-ols called catechins which include: (-)-epicatechin (EC), (-)-Epigallocatechin (EGC), (-)-epicatechin gallate (ECG), (-)-epigallocatechingallate (EGCG), (-)-Gallocatechins (GC) and (-)-gallocatechin gallate (GCG). Catechins are present in large amounts in green tea (Peterson et al., 2005). Based on their chemical structure, catechins that contain three hydroxyl groups in the B ring (positions 3', 4' and 5') are called gallocatechins, while gallic acid substitution in position 3 of the ring is a characteristic of catechin gallate (Pellilo et al., 2008). Catechins account for 6 - 16% of the dry green tea leaves with EGCG constituting 10 - 50% of catechins and being the most potent due to its degree of gallation and hydroxylation (Stewart et al., 2009). TFs and TRs are another group of polyphenolic compounds found in both black and oolong teas (Oband et al., 2001). The tea beverage has continued to be considered a medicine since the ancient times because of its polyphenols. Research on the effects of tea on human health has been fuelled by the growing need to provide naturally healthy diets that include plant-derived polyphenols. In line with this, there is need to elucidate how known functional components in foods could expand the role of diet in disease prevention and treatment (Mandel et al., 2006). There is already growing evidence that tea polyphenols reduce the risk of heart diseases and cancer in humans (Vanessa and Williamson, 2004). In some studies, tea has been associated with antiallergic action (Jamamoto et al., 2004) and antimicrobial properties (Paola et al., 2005). Further studies have demonstrated that the co-administration of drugs with catechins (EC and EGCG) inhibits glucoronidation and sulfonation of orally administered drugs, thereby increasing the bioavailability of such drugs (Hang et al., 2003). Moreover, some epidemiological studies have associated consumption of tea with a lower risk of several types of cancer including those of the stomach, oral cavity, oesophagus and lungs (Cabrera et al., 2003; Hakim and Chow, 2004). Therefore, tea appears to be an effective chemopreventive agent for toxic chemicals and carcinogens.

Statistical ANOVA analysis of total phenol content (mg GAE/g Dw) of tea samples dried with different drying methods and obtained from organic fertilizer applications is shown in Table 1. The corresponding total phenol content values is shown in Figure 1 and Table 2. The ANOVA analysis of phenolic content values of tea samples showed high significant differences between drying methods, applied organic fertilizer doses and drying method x drying method interaction (Table 1).

The calculated coefficient of variation (1.32%) is relatively low, because the allowed top level in field trials is 20%.

The results showed that the phenolic content of white tea

<table>
<thead>
<tr>
<th>Source</th>
<th>Degree of freedom</th>
<th>Sum of squares</th>
<th>Mean of square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>44</td>
<td>27178.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replication</td>
<td>2</td>
<td>66.323</td>
<td>33.16</td>
<td>0.89</td>
</tr>
<tr>
<td>Combination</td>
<td>14</td>
<td>26075.76</td>
<td>1862.55</td>
<td>50.30**</td>
</tr>
<tr>
<td>Drying method (DM)</td>
<td>2</td>
<td>9630.09</td>
<td>4815.04</td>
<td>130.04**</td>
</tr>
<tr>
<td>Organic fertilizer Dose(F)</td>
<td>4</td>
<td>15406.86</td>
<td>3851.71</td>
<td>104.02**</td>
</tr>
<tr>
<td>DM x F</td>
<td>8</td>
<td>1038.81</td>
<td>129.85</td>
<td>3.506*</td>
</tr>
<tr>
<td>Error</td>
<td>28</td>
<td>1036.77</td>
<td>37.027</td>
<td></td>
</tr>
</tbody>
</table>

CV = 1.32%.

Table 1: ANOVA of phenolic content white tea samples using values obtained from drying methods and organic fertilizer doses.
Table 2: Phenolic content values (mg GAE/g DW) of white tea samples obtained from different drying methods and organic fertilizer doses.

<table>
<thead>
<tr>
<th>Drying method</th>
<th>Fertilizer doses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>Drying oven</td>
<td>443.74 f</td>
</tr>
<tr>
<td>Shadow</td>
<td>421.43 i</td>
</tr>
<tr>
<td>Lyophilizator</td>
<td>434.45 gh</td>
</tr>
<tr>
<td>Mean</td>
<td>433.20 d**</td>
</tr>
</tbody>
</table>

*Means with the same letter are not significantly different from each other (P>0.05).
**Means with the same letter are not significantly different from each other (P>0.01).

samples was as follows: 443.74- 508.15 mg GAE/g DW in the drying oven, 419.0- 479.0 mg GAE/g DW in shadow and 431.35- 487.71 mg GAE/g DW in the lyophilizator (Table 2).

As shown in Table 2 and Figure 1, total phenol content of white tea samples increased in every used drying method beginning from the control up to every organic fertilizer dose of 500, 1000, 1500 and 2000 kg/ha. Drying oven and lyophilizator methods were found in the same group, differing from shadow drying. As regards fertilizer doses, the dose 2000 kg/ha was very different from the other fertilizer doses; 1000 and 1500 kg/ha were in the same group. The dose 500 kg/ha and control were grouped separately in the groups c and d, respectively.

Regarding drying method x organic fertilizer interaction, the highest phenolic content value was obtained in samples applied with 2000 kg/ha organic fertilizer and dried in the lyophilizator (506.29 mg GAE/g DW).

Shannon et al. (2017) compared the total phenolic content (TPC), total flavonoid content (TFC), ferric reducing antioxidant power (FRAP), DPPH radical scavenging capacity, and caffeine content of teas (black, green, white, chamomile, and mixed berry/hibiscus) over a range of infusion times (0.5–10 mins) at 90°C. In this study, green tea had the highest total phenolic content of 557.58 ± 74.98, followed by black 499.19 ± 46.56, white 190.24 ± 7.73; berry 98.86 ± 14.72, and chamomile 75.31± 3.65 μg GAE/g tea. Unachukwu et al. (2010) quantified a TPC of 1.17mg GAE/g in green tea and 0.96mg GAE/g in white tea. In this study, green tea was found to have the highest level of total phenolics (Komes et al., 2010; Anissi et al., 2012), followed by black tea, while the chamomile, berry, and white teas were significantly lower (P ≤ 0.05). White tea, although from the same C. sinensis plant as black and green varieties, may have a lower TPC due to the fact that oxidation by polyphenol oxidase is prevented in white tea processing (Astorino et al., 2014). Therefore, the phenolic monomers in the fresh leaves are not complexed into polyphenols such as catechins in green tea, or thearubigins in black tea. Rusak et al. (2008) reported that the extraction of total phenolics from white tea leaves occurred at a significantly slower rate.
Table 3: ANOVA of white tea samples using values obtained from drying methods and organic fertilizer doses.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degree of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>44</td>
<td>74311.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replication</td>
<td>2</td>
<td>17.80</td>
<td>8.90</td>
<td>0.218</td>
</tr>
<tr>
<td>Drying Method (DM)</td>
<td>2</td>
<td>3330.06</td>
<td>1665.03</td>
<td>40.667**</td>
</tr>
<tr>
<td>Organic Fertilizer Dose (F)</td>
<td>4</td>
<td>36481.60</td>
<td>9120.40</td>
<td>222.77**</td>
</tr>
<tr>
<td>DM x F</td>
<td>8</td>
<td>33335.79</td>
<td>4166.97</td>
<td>101.78**</td>
</tr>
<tr>
<td>Error</td>
<td>28</td>
<td>1146.35</td>
<td>40.94</td>
<td></td>
</tr>
</tbody>
</table>

CV = 0.558%.

Figure 2: Antioxidant capacity of white tea samples obtained from different drying methods and organic fertilizer doses.

Table 4: Antioxidant activity values of white tea samples obtained from different drying methods and organic fertilizer doses

<table>
<thead>
<tr>
<th>Drying method</th>
<th>fertilizer doses</th>
<th>Control</th>
<th>500 kg/ha</th>
<th>1000 kg/ha</th>
<th>1500 kg/ha</th>
<th>2000 kg/ha</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying oven</td>
<td></td>
<td>1130.13 l**</td>
<td>1145.85 gh**</td>
<td>1161.96 c-f**</td>
<td>1168.96 bc**</td>
<td>1176.89 ab**</td>
<td>1156.76 a**</td>
</tr>
<tr>
<td>Shadow</td>
<td></td>
<td>1141.23 hi**</td>
<td>1142.42 hi**</td>
<td>1145.59 gh**</td>
<td>1156.02 e-g**</td>
<td>1157.08 d-g**</td>
<td>1148.51 b**</td>
</tr>
<tr>
<td>Lyophilizator</td>
<td></td>
<td>1005.31 j**</td>
<td>1159.19 c-f**</td>
<td>1163.02 c-e**</td>
<td>1168.30 b-d**</td>
<td>1183.36 a**</td>
<td>1135.84 c**</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>1092.22 d**</td>
<td>1149.15 c**</td>
<td>1156.86 bc**</td>
<td>1164.43 b**</td>
<td>1242.44 a **</td>
<td></td>
</tr>
</tbody>
</table>

**Means with the same letter are not significantly different from each other (P>0.01).

than that of other teas. The range of determined phenolic content was between 421.44 and 506.29 µg GAE/g DW for all applications and these values are higher.

Antioxidant activity

Statistical ANOVA analysis of antioxidant activity values (mg FeSO4/g DW) of tea samples dried with different drying methods and obtained from organic fertilizer applications can be seen in Table 3, and corresponding antioxidant values are shown in Figure 2 and Table 4.

The ANOVA analysis of antioxidant activity values of tea samples revealed very significant differences between drying methods, applied organic fertilizer doses and drying method x drying method interaction (Table 3).

According to the FRAP method, the antioxidant activity was as follows: 1124.585-1181.25 mg FeSO4/gr DW in drying oven, 1132.907-1160.249 mg FeSO4/gr DW in shadow and 997.3859-1185.609 mg FeSO4/gr DW in...
liofilizator.

As shown in Table 4 and Figure 2, antioxidant activity of white tea samples increased in every used drying method beginning from the control up to every organic fertilizer dose of 500, 1000, 1500 and 2000 kg/ha. All drying methods; drying oven, shadow and liophilizator, were grouped into a, b and c, respectively. Regarding statistical analysis results, the fertilizer dose 2000 kg/ha was determined as the most effective dose in group a

Natural antioxidants are increasingly appreciated by consumers due to both their inherent positive effects (Oh et al., 2013) and the possibility of using them as a source of natural additives to replace synthetic ones (Gülçin, 2012; Silva-Weiss et al., 2013; Perumalla and Hettiarachchy, 2011). Tea, a natural plant, is a rich source of natural antioxidants and provides a high free radical scavenger activity (Gramza and Korczak, 2005; Almajano et al., 2008). In our study, antioxidant activity of white tea samples obtained from different drying methods and organic fertilizer doses showed high amounts of antioxidant activity.

Conclusion

Organic tea production will not be an issue in Turkey in the future. Govermental institutions like ÇAYKUR and the private sector are searching for suitable and high yield performing organic fertilizers in Rize, Turkey. The primary focus is the income, which of course means total fresh leaf yield, of local farmers, because tea is the biggest income in this region.

However, yield only is not sufficient for the production of different tea types, also their phenolic contents and antioxidant activity values are not very important. In the present study, the effect of different drying methods and organic fertilizers on the phenolic content and antioxidant activity of white tea were investigated for the first time in Rize, Turkey. For both investigated quality characters, 2000 kg/ha was the best organic fertilizer dose, but the highest values regarding drying methods were obtained from the drying oven in all fertilizer doses considering phenolic content. From the obtained antioxidant activity values, it can be stated that all investigated samples displayed high amounts of these investigated quality character.

Based on the obtained first year results, it can be stated that high potential exists in organic tea production regarding the increase of phenolic content and antioxidant activity in tea. To develop arguments for the whole tea plantation area in Turkey, samples from different locations in these region should be investigated.

REFERENCES


