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The Effects of Different Doses of Organic Chicken Fertilizer on the Element Analysis of Sweet Basil (Ocimum basilicum L.)

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ABSTRACT: *Sweet basil (**Ocimum basilicum** L.) genus belonging to the Lamiaceae family is an important aromatic plant cultivated in many parts of the world for its essential oil The present study was performed to determine the effects of different organic chicken fertilizer doses (0,750, 1000, 1250 and 1500 kg/da) on some elements of sweet basil. The experiments were established in Bolu location (40°41' 28" N, 31°32' 38"E, 760 m elevation), during the years 2015-2016. The ions in aerosol samples were determined by using Dionex ICS 1100 Series ion chromatography. In leaves, the highest K^+ and Cl^- contents were observed in the control (0 kg/da) application (41.50 mg/g and 11.90 mg/g), the highest PO_4^{-3} and Mg^{+2} contents were detected in 750 kg/da organic chicken fertilizer (12.3 mg/g and 1.99 mg/g), the highest Ca^{+2} content was detected in 1000 kg/da organic chicken fertilizer (22.6 mg/g), the highest SO_4^{-2} content was detected in 1500 kg/da organic chicken fertilizer (84 mg/g) and the lowest Ca content was observed in 1500 kg/da organic chicken fertilizer (6.22 mg/g) and the lowest PO_4^{-3} and Cl^- contents were detected in 1250 kg/da organic chicken fertilizer (8.14 mg/g, 8.34 mg/g). As a result of this research, 750 and 1000 kg/da application of organic chicken fertilizer dose had significant effect on some elements of sweet basil.*

Keywords*: Sweet basil, **Ocimum basilicum** L., organic chicken fertilizer, element content.*

Organik Tavuk Gübresinin Farklı Dozlarının Fesleğen (Ocimum basilicum L.)'in Element Analizine Etkileri

ÖZ: *Lamiaceae familyasına ait fesleğen (**Ocimum basilicum** L.), dünyanın birçok yerinde uçucu yağı için yetiştirilen önemli bir aromatik bitkidir. Bu çalışma, farklı organik tavuk gübresi dozlarının (0,750, 1000, 1250 ve 1500 kg/da) fesleğen bitkisinin bazı elementleri üzerine etkilerini belirlemek amacıyla, 2015-2016 yıllarında Bolu lokasyonunda (40°41' 28" K, 31°32' 38"D, 760 m rakım) yürütülmüştür. Aerosol numunelerindeki iyonlar, Dionex ICS 1100 Seri iyon kromatografisi kullanılarak belirlenmiştir. Bitki yapraklarında en yüksek element içeriklerine, K^+ (41.50 mg/g) ve Cl (1.90 mg/g) kontrol şartlarında, Ca^{+2} (22.6 mg/g) 1000 kg/da organik tavuk gübre uygulamasında, PO_4^{-3} (12.3 mg/g) ve Mg^{+2} (1.99 mg/g) 750 kg/da organik tavuk gübre uygulamasında, SO_4^{-2} (4.84 mg/g) 1500 kg/da organik tavuk gübre uygulamasında ulaşılırken, en düşük element içeriklerine Ca^{+2}(6.22 mg/g) 1500 kg/da organik tavuk gübre uygulamasında, PO_4^{-3} (8.14 mg/g) ve Cl^- (8.34 mg/g) 1250 kg/da organik tavuk gübre uygulamasında ulaşılmıştır. Bu araştırmanın sonucunda, 750 ve 1000 kg/da organik tavuk gübre dozlarının fesleğenin bazı elementleri üzerine olumlu etkileri olduğu saptanmıştır.*

Anahtar Kelimeler: *Fesleğen, **Ocimum basilicum** L., organik tavuk gübresi, element içeriği.*

INTRODUCTION

Sweet basil (*Ocimum basilicum* L.), a member of the Lamiaceae family is an annual herb which grows in several regions around the world. Among more than 150 species of the genus *Ocimum,* sweet basil is the major essential oil crop which is cultivated commercially in many countries (Sajjadi, 2006). Sweet basil does not show natural

distribution in Turkey, but they are cultivated as medicinal, seasoning or oil plants especially in the western and southern Anatolia. Its leaves contain 0.5-2 % essential oil and methyl chavicol (estragol), eugenol, linalool, methyl cinnamate and camphor are the important components of essential oil of basil leaves. Due to the chemicals contained in essential oils, essential oils of sweet basil are used for treatment of dry mouth and dental complaints, diarrhea and chronic dysentery, respiratory disorders, and effective in the treatment of fungal diseases and stomach discomfort in addition, the influential antitussive, diuretic, anthelminthic, tranquilizer and expectorant roles in medicinal approach. Moreover, ceasing nasal-bleeding and preventing constipation, good for fatigue and insomnia, and uses for healing migraine headaches and incomplete paraplegia were reported (Telci *et al*., 2006). However, recently the potential uses of sweet basil essential oil, particularly as antimicrobial and antioxidant agents have also been investigated (Suppakul *et al*., 2003; Sartoratotto *et al*., 2004; Lee *et al*., 2005; Wannissorn *et al*., 2005; Politeo *et al*., 2007). Minerals are important in human nutrition. It is well known that enzymatic activities as well as electrolyte balance of the blood fluid are related to adequacy of Na, K and Mg. Potassium is very important in maintaining the body fluid volume and osmotic equilibrium. Metal deficiency syndrome like rickets and calcification of bones is caused by calcium deficiency. Several studies on nutrition in developing countries have shown that adequate nutrient intake (daily calories, daily protein, daily fat, minerals and vitamins) is an essential ingredient for improved well-being, economic growth and development, since a healthy body enhances the capacity to learn which in turn determines productivity and economic growth (Flores, 2001; Smith and Haddad, 2001; Diao *et al*., 2007). The objective of this work is to estimate the concentration of some nutrient elements of different doses of organic chicken fertilizer for sweet basil.

MATERIALS AND METHODS

The present study was performed to determine the effects of organic chicken fertilizer application of different doses on some elements of sweet basil during 2015-216 years in Bolu location (40°41′ 28″ N, 31°32′ 38″E, 760 m elevation). In this context, five different doses (0, 750, 1000, 1250 and 1500 kg/da) were applied. The experiments were arranged in the Completely Randomized Blocks Design with three replications in May in 2015 and 2016 in open-field conditions. Each experimental plot consisted of five rows that were a row-to-row distance of 0.3 m and plant-to-plant distance of 0.2 m. Sweet basil was regularly irrigated to demonstrate good progress in its period vegetation since irrigation is a very important factor for cultivation of basil. Soil properties of experimental fields were as follows: rich in phosphorus (12.19 ppm), potassium (51.04 ppm) and organic matter (3.1%), clay-loam and slightly alkaline (pH=7.6). Climatic data during the vegetation period of the experimental years (may-september) was 19.1 ^{o}C (average temperature), 259.1 mm (total rainfall) and 71.2% (average humidity) (Anonim, 2016). The properties of organic chicken fertilizer is given in Table 1 (Anonymous, 2017).

Table 1. Properties of the organic chicken fertilizer.
Çizelge 1. Organik tavuk gübresinin özellikleri.

Analysis Parameters	Unit	Analysis results (W/W)
EC	dS/m	2.6
Organic matter	%	72.6
Beneficial ratio	%	60-65
Total Humic and Fluvic Acid	%	61.5
pH	-	6.2
Moisture	%	19.8
Total N	%	2.2
Total P_2O_5	%	1.76
Water soluble K_2O	%	1.62
Organic N	%	1.4
C/N	-	17.4
Organic Carbon	%	38.4

Estimation of element content

To prepare the samples for the element content determination, 5 g of samples were extracted with

50 mL deionized water, in ultrasonic water bath during 30 minutes. Then, extracts were filtered with 0.22 µm cellulose acetate filter and prepared for the analysis. Before sample analysis, the standard Dionex anion mix and Dionex cation mix were used for calibration. The ions in aerosol samples were determined by using Dionex ICS 1100 Series ion chromatography (Table 2). The results were checked by using the ERM-CA408 simulated rainwater (low contents). Operation conditions of the instrument are given in Table 3.

The results were checked by using the ERM-CA408 simulated rainwater (low contents). The percent error was shown in Table 3. The analysis of the element contents were the average of three replicates of field experiment.

RESULTS

The present study was conducted for the evaluation of elements such as Calcium (Ca^{+2}), Magnesium (Mg^{+2}), Lithium (Li^{+}), Amonyum (NH_4^{+}), Potassium (K^{+}), Sodium (Na^{+}), Fluoride (F^{-}), Chloride (Cl^{-}), Nitrite (NO_2^{-}), Nitrate (NO_3^{-}), Sulfat (SO_4^{-2}), and Phosphorus (PO_4^{-3}) in the leaves of sweet basil. The results indicated that the leaves contain highest concentration of K^{+}, Ca^{+2}, PO_4^{-3} and Cl 41.50, 22.6, 12.30 and 11.90 mg/g and lowest concentration of Mg (1.39 mg/g) and SO_4^{-2} (2.73 mg/g), respectively (Table 4).

Table 2. Optimum operation conditions for Dionex ICS 1100 Ion Chromatography.
Çizelge 2. Dionex ICS 1100 İyon Kromatografisi için optimum çalışma koşulları.

Operation conditions Çalışma koşulları	Anion Anyon	Cation Katyon
Mobile phase (Mobil aşama)	9 mM Na_2CO_3	20 mM Metansulfonic acid
Column (Sütun)	Ionpac AS9-HC (250 x 4 mm)	Ionpac CS12-A (250 x 4 mm)
Guard column (Koruma sütunu)	Ionpac AG9-HC (50 x 4 mm)	Ionpac CG12-A (50 x 4 mm)
Supressor (Süpressör)	ASRS-4 mm	CSRS-4mm
Supressor current (Süpressör akımı)	45 mA	65 mA
Detector (Dedektör)	Conductance detector	Conductance detector
Pressure (psi) (Basınç)	2000-3000	2000-3000
Oven temperature (Fırın sıcaklığı)	30 ^{o}C	30 ^{o}C
Background conductance (Arkaplan iletkenliği)	< 30 µS	0.5-2 µS
Flow rate (Akış hızı)	1.00 mL/min	1.00 mL/min
Injection volume (Enjeksiyon hacmi)	500 µL	1000 µL
Rate of data transfer (Veri aktarım hızı)	5.0 Hz	5.0 Hz
Duration (Süre)	30 min	15 min

Table 3. ERM-CA408 simulated rainwater (low contents) results.
Çizelge 3. ERM-CA408 yağmur suyu (düşük içerikler) benzeri sonuçlar.

Element Element	Certified value (mg/L) Belirlenmiş değer	Uncertainty Belirsizlik	Aritmetic mean (mg/L) Aritmetik ortalama	Standard deviation Standart sapma	Error (%) Hata
NH_4^{+}	0.910	0.028	0.789	0.03870	-13.300
Mg^{2+}	0.145	0.022	0.113	0.01220	-21.700
F^{-}	0.194	0.008	0.187	0.00481	-3.150
Cl^{-}	1.960	0.070	1.940	0.01350	-0.730
NO_3^{-}	2.010	0.090	1.970	0.02110	-1.700
SO_4^{2-}	1.460	0.040	1.490	0.02910	2.390

Table 4. Concentration of elements in *Ocimum basilicum* (mg/g) by different doses of organic chicken fertilizer.
Çizelge 4. Organik tavuk gübresinin farklı dozlarına bağlı olarak *Ocimum basilicum* (mg/g) bitkisindeki element konsantrasyonları.

Organic chicken fertilizer doses Organik tavuk gübre dozları	K^+	Mg^{+2}	Ca^{+2}	Cl^-	PO_4^{-3}	SO_4^{-2}
Control (Kontrol)	41.50	1.71	7.66	11.90	10.60	3.06
750 kg/da	35.70	1.99	13.50	10.6	12.30	4.10
1000 kg/da	35.04	1.94	22.60	10.4	9.60	2.73
1250 kg/da	37.0	1.94	14.80	8.34	8.14	3.18
1500 kg/da	37.60	1.39	6.22	8.55	10.09	4.84

All tested extracts did not include NH_4^+, F^-, Na^+, NO_2^-, NO_3^-, Li^+ elements. In this study, the concentration of Mg ranged from 1.39 to 1.99 mg/g. The highest value was determined from 750 kg/da of organic chicken fertilizer application in sweet basil leaves, and the lowest value was determined from 1500 kg/da of organic chicken fertilizer application in sweet basil leaves (Table 4). Mg has got prime role in the maintenance of normal physiology in all living organisms. Mg prevents cardiac arrhythmia disorders, high blood pressure (Witte et al., 2008; Soetan et al., 2010). K concentrations of sweet basil varied between 35.04 and 41.50 mg/g. Control (0 kg/da) application demonstrated highest K concentration (41.50 mg/g) compared to other organic chicken fertilizer leaves extracts applied. The importance of K is speculated from its participation in large number of biological processes, such as acid base balance, movement of muscles, nerve impulse conduction, and regulation of osmotic pressure (Hajjar et al., 2001). Ca concentrations of sweet basil varied between 6.22 and 22.60 mg/g (Table 4). While the highest values were obtained from 1000 kg/da of organic chicken fertilizer application in sweet basil leaves, the lowest values were obtained from 1500 kg/da of organic chicken fertilizer application in sweet basil leaves. Ca is an extremely important element in human body. Ca plays a significant role in building strong bones teeth and heart functions (Brody, 1994). Ca may result in tetany and convulsions due to impetuous discharges of nerve impulses. The recommended daily Ca intake required for normal biochemical activities of the body is 1500 mg (Hassan et al. 2015). Cl was present in the range of 8.34-11.90 mg/g. The highest concentration was present in control application followed by 750 kg/da (10.60 mg/g). SO_4^{-2} concentrations of sweet basil ranged from 2.73 to 4.84 mg/g. While its maximum content (4.84 mg/g) was presented in 1500 kg/da organic chicken fertilizer application, and its minimum content (2.73 mg/g) was presented in 1000 kg/da organic chicken fertilizer extracts. In the present study, the concentration range of PO_4^{-3} was 8.14-12.30 mg/g, as shown in (Table 4). The highest level of that form of PO_4^{-3} was found in 750 kg/da of organic chicken fertilizer application followed by control doses of organic chicken fertilizer application (10.60 mg/g).

DISCUSSION

According to the results obtained from this study, the highest mineral values were found in organic chicken fertilizer application at 750-1000 kg/da (Table 4). According to the earlier scientific studies conducted on nutritive composition of wild plants, high quantities of minerals can be found especially in K, Na, Ca, P and Mg (Guil Guerrero et al., 1998; Agrahar-Murugkar and Subbulakshmi, 2005). The metal ions including Fe^{3+}, Zn^{2+}, $Mg^{2+,}$ K^+, Ca^{2+} and some other micronutrients are cofactor for nearly 100 enzymes, which are involved in cell division, nucleic acid metabolism and protein synthesis. The researches have shown that application of micronutrients reduces the effects of environmental stresses (Cakmak and Hors, 1991). Ozcan (2002) determined the mineral contents of 32 plants used as condiments in Turkey and as a result Al, Ba, Ca, Fe, K, Mg, P and S contents were high in all plants analyzed. B, Mg, S, Sr, Zn contents of basil were found as 31.75 ppm, 5737.8 ppm, 1923 ppm, 141.97 ppm, 13.71 ppm, respectively. Lavilla *et al*., (1999) indicated that *O. basilicum* contented Mg (7458 mg/g) and

Ca (21500 mg/g). Yamawaki *et al*., (1993) reported that one hundred grams of fresh basil leaves contained 250 mg of calcium, 37 mg of phosphorus, 5.5 mg of iron, and 11 mg of magnesium. Daniel *et al*., (2011) reported that *O. basillicum* exhibited high potassium content (28.770 mg/kg), calcium (17.460 mg/kg) and appreciable quantity of sodium (290 mg/kg) and magnesium (266 mg/kg). Tarchonue *et al*., (2012) reported that the concentration of the accompanying anions had an important role in *O. basilicum* in response to salinity. They indicated a marked selectivity for K^+ and Ca^{2+} over Na^+ with values of selectivity ratio significantly increasing with both Na_2SO_4 and NaCl salinity treatments. They also indicated Mg^{+2} and Sulphate content was decreased significantly by both treatments as compared to the controls, but Cl^- and SO_4^{-2} anions were found at high concentration in basil affected by NaCl and Na_2SO_4 treatments, respectively. Tewari *et al*., (2012) indicated that *O. basilicum* contented Na (85.9±1.29), K (397.57±4.12), Ca (1133.4±0.04), Li (6.66±1.15), Fe (59.83±1.5), Cu (1.26±0.03), Mn (5.73±0.12), Co (0.16±0.21), Zn (16.06±0.84) mg/100g. The contents of Ca and K obtained from the present study are higher compared to the results of researches. The differences between our results and earlier studies may be due to the applications of different organic chicken fertilizer, use of different extracts for analysis, different environmental and genetic factors.

CONCLUSION

In this study, among all the extracts analyse, 750 and 1000 kg/da organic chicken fertilizer applications had higher element content than the control and other organic chicken fertilizer applications. It was also shown that sweet basil leaves are rather rich sources of K^+, Ca^{+2}, PO_4^{-3}, NO^{3-}, NO^{2-} and Cl^- and potentially bioavailable for human consumption.

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