Progress in Nutrition 2018; Vol. 20, N. 4: 679-687 DOI: 10.23751/pn.v20i4.6810

Original article

The nutritional aspects of oak wood-fired cooked pepper consumption in adiyaman, southeastern anatolia (Turkey)

Çiğdem Sabbağ[1], *Erhan Akça*[2]

[1]Associate Professor, Adıyaman University, School of Tourism, 02040, Adıyaman, Turkey, csabbag@adiyaman.edu.tr; [2]Professor, Adıyaman University, School of Technical Sciences, 02040, Adıyaman, Turkey, eakca@adiyaman.edu.tr,

Summary. Bell pepper (Capsicum annuum) is a widely consumed vegetable in many regions of Turkey and Adıyaman (SE Turkey) is one of the leading regions for production and consumption. In Adıyaman, cooked consumption of pepper is preferred, particularly eating oak wood-fired oven cooked pepper is a common ritual in summers. Nutrition analyses in fresh and cooked bell pepper were done to determine the nutrition properties of pepper. Along with plant analyses, soils analyses were undertaken to evaluate macro and micronutrient continuum from soil to plants. It was determined that the most of the macro and micronutrient contents of pepper were within the normal range however, soils' zinc, calcium, iron and organic matter were low. Contrary to these low values, the high phosphorus level (8.5-9.9 kg.da-1) in both sample areas indicate unbalanced fertilization management in the region. The fat-soluble vitamin E along with water-soluble C, B1, B2, B3, B6 and folate acid content of Adıyaman peppers were higher than reference values that revealed their quality.

Key words: Bell Pepper, oak wood, stone oven, breakfast, Adıyaman

Introduction

Pepper (Capsicum annum L.) is consumed by humans for 7000 years because of its water, protein, fat, carbohydrate, fiber, minerals and vitamins content (1). Although it has been introduced 300 years ago in Anatolia (modern Turkey) it has risen to third place in production with 198.600 tons after China and Mexico (2). The high production is not only for export but locals intensively consume pepper. Because of suitable geographic growing conditions and favorable taste to people, pepper is produced intensely in Southeastern Anatolia. Pepper, although introduced to the Anatolian kitchen rather late compared to many other vegetables and fruits, became an indispensable food for the local meals since then. During pepper season, it is consumed from breakfast to dinner in Adıyaman as fresh or mostly cooked in salads, garniture, paste and dry forms (2). This high consumption has led to the perception of pepper as traditional food. It contains high levels of natural antioxidants, carotenoids, polyphenols as well as vitamins C, A, B1, B2 and B3 (3). Suchankov *et al.* (4) reported that peppers are among the vegetables with the optimal nutritional value per unit weight with their vitamins A, C, E, folic acid, thiamine, riboflavin, calcium, iron, potassium and magnesium contents. However, even though pepper has been known that it is beneficial for human nutrition, this study investigated to what extent the pepper consumption meet the daily necessities and evaluated the high consumption effect on human health.

Along with these nutritional facts, eating wood-fired stone oven-cooked pepper is a routine breakfast event in summers (2). This drives people to have breakfast with friend rather than household members, and breakfast become a kind of daily gathering event for the society. Oak wood-fired stone ovens are common in Adıyaman, and people said that their preference for kind of cooking is the taste and smell effect of oak. Oak is a natural tree in Adıyaman maquis vegetation and, locals claimed that naturally grown oak wood smoke gives a unique taste to pitta and foods prepared in them. Thus, the oak wood fueled stone ovens became the hearth of Adıyaman cuisine.

Material and methods

Pepper samples

This study was carried out in Adıyaman located in Southeastern Anatolia Region of Turkey. Pepper is the 5th crop in Adıyaman with 13548 tons in all agricultural products (2). Pepper samples were taken from Luvisol and Cambisol soils (5) overlays on sloping and flat terrains respectively. Pepper in the region is generally consumed when green, thus the samples were collected before peppers became red ie before full maturation. One kg green pepper were harvested in the early morning hours in each site and delivered to the laboratory within 24 hours after being kept between at 4^{o}C in vacuumed polyethylene bags. Nutrient content analysis was carried out on freshly baked samples, the most common cooking method of the region. Cooking was done in ovens where oak wood is used as a fuel at about 250-300^{o}C for 10 minutes. Among the traditional methods of preparing pepper, roasting is the most common type of catering. Although this method is very common, the firing effect on pepper nutrient content has not been studied sufficiently. For this purpose, energy, protein, fat, carbohydrate, vitamins A, B, C, E group, potassium (K), calcium (Ca), iron (Fe) and phosphorus (P) contents were determined in fresh and cooked samples. ICP-OES (700 ICP-OES Agilent Technologies) and HPLC (1100 Series, Agilent Technologies) devices were used to determine energy and nutrient quantities of fresh and cooked pepper samples. The obtained nutritional values were compared with USDA (6) and various studies provided in Table 2.

Soils Samples

Soil samples were collected from the fields of irrigated pepper cultivation at slightly sloping (2%, Leptic Luvisol Vertic, Clayic S1) and flat (<1%, Vertic Cambisol Colluvic, Clayic S2) (5) areas by taking into account the genetic horizons and depth of root development (Figure 1). The studied soils have moderate deep soil profiles without stone.

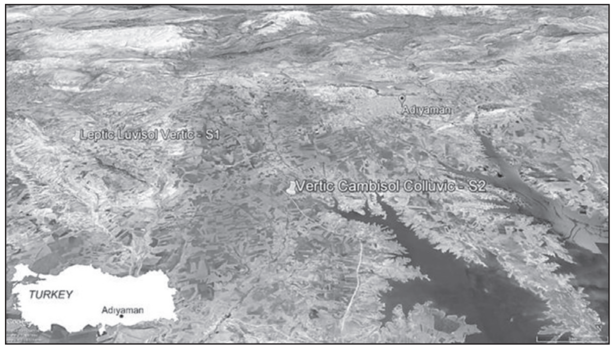

Figure 1. Pepper Sampling locations in SE Turkey

Soils' pH, electrical conductivity, lime, texture, organic matter, organic carbon (t C ha-1), zinc, iron, copper, phosphorus and manganese (7, 8, 9, 10) that are effective on plant production were analysed at air dried soil samples that are sieved from 2mm steel sieves. In the calculation of organic carbon, the bulk density of soil was taken as 1.3$g.cm^3$. And equation below was used:

Equation 1. Organic Carbon t C ha=SD (cm) x BD ($g.cm^3$) x 10000 m^2 x TOM (%)

where SD is soil depth (cm), BD is bulk density ($g.cm^3$), and TOM is Total Soil Organic Matter (%).

Nutritional analyses

Energy

The fresh and oven cooked peppers energy was calculated ($kcal.100g^{-1}$ fresh weight) by Atwater method (11) which uses the protein, carbohydrates and fat values by multiplying them with 4.00, 3.75 and 9.00, respectively (Equation 2).

Equation 2: Energy value ($kcal.100g^{-1}$): (CPx4) + (CFx9)+(Carb.x4)

Chemical analyses

The water content, fat and proteins of fresh and cooked samples were determined by methods given in Association of Official Analytical Chemists (AOAC) (12). The moisture contents were measured at 2g dried samples that were placed in 1000^{o}C air oven for 24h. While fat amounts of peppers were measured at samples extracted with soxhlet solvent, protein was calculated with macro Kjeldahl method at samples treated with copper sulfate: sodium sulfate (5:1) followed by addition of 25ml of concentrated sulfuric acid. The readings were observed until the green color changed to purple with HCl added boric acid titration (12). The total dietary fiber (TDF), insoluble dietary fiber (IDF) and soluble dietary fiber (SDF) content of the prepared pepper samples were determined by enzymatic gravimetric method as described in AOAC 991.43 (12).

Mineral Content

The fresh and cooked peppers', potassium (K), calcium (Ca), iron (Fe) and phosphorous (P) contents were measured with ICP-OES. Analyses were made by dissolving the minerals in the sample with closed microwave wet ashing system (13).

Vitamin analyses

B Group vitamins

The B group vitamin analyses of fresh and oven-cooked peppers, employed at 2g each, comprise an acid hydrolysis and enzymatic treatment for the determination of vitamin B1, B2, B3 and B6 with HPLC-FLD equipment (12). Vitamin B9 requires a diversified method than other vitamin B analysis, and it is calculated microbiologically with Lactobacillus rhamnosus (12).

Vitamin C

For Vitamin C analyses 10g powdered samples were used. Fresh and cooked peppers' vitamin C (ascorbic acid + dehydroascorbic acid) contents were measured by extraction in an aqueous trichloroacetic acid and antioxidanttris phosphine solution. The final extracts were analyzed with HPLC with UV detection at 265 nm (1100 Series, Agilent Technologies) (14).

Vitamin E (Alpha-tocopherol)

Vitamin E (α-tocopherol) of the samples were calculated by alkaline hydrolysis using ethanolic potassium hydroxide solution which was extracted with hexane:ethylacetate mixture. The extracts' vitamin E was measured with HPLC-FLD (12).

Results and discussions

Soil Properties

Pepper farming in Adıyaman is generally carried out in the non-calcareous and low carbonate containing (<2%) red Mediterranean soils. Soils that are not calcareous and clay illuviated are classified as "Leptic Luvisol Colluvic Clayic" and the ones with low carbonate and slightly deeper are as "Vertic Cambisol Colluvic Calcaric" (5) (Table 1). The cation exchange capacity (>32.3 cmolkgg-1), which is relatively high in

Table 1. The physical and chemical properties of pepper cultivated soils in Adıyaman

	Depth	**pH**	**EC**	**Cation Exchange Capacity**	**CaCO3**	**Organic matter (%)**	**Sand**	**Silt**	**Clay**	**Texture**	**Bulk Density**	**P2O5**	**Zn**	**Cu**	**Fe**	**Mn**
						Leptic Luvisol Colluvic Clayic –S1										
Horizon	cm	1:1	dSm-1	cmolckg-1	%	%		%			g.cm3	kg/da		ppm		
Ap	0-16	7	0.04	33.4	-	0.9	28	27	45	Clay	1,32	8.5	0.7	2.7	6.7	5.6
BA	16-35	7	0.04	39.6	-	0.8	21	22	57	Clay		4.2	0.3	1.7	3.2	6.3
Bt	35-46	7.1	0.10	43.8	0.8	0.7	21	19	60	Clay		2.6	0.2	1.1	5.8	7.2
Bw	46-63	7.5	0.07	38.3	3.5	0.4	27	18	55	Clay		2.2	0.2	0.9	4.7	3.6
						Vertic Cambisol Colluvic Calcaric –S2										
Ap	0-18	7.4	0.08	30,8	2,1	1.1	24	32	44	Clay	1,33	9.9	0.5	2.3	4.3	4.3
Ad	18-38	7.4	0.10	30,8	2,2	0.9	24	32	44	Clay		4.3	0.1	1.9	3.8	5.6
Bw	38-51	7.7	0.10	26,4	3.8	0.8	30	34	36	Clay Loam		1.7	0.2	1.7	2.5	5.8
Bk	51-67	7.7	0.11	26.3	6.7	0.6	25	39	36	Clay Loam		0.7	0.3	0.8	2.6	4.3

clay and clay loam soils shows the presence of smectite-type clay minerals in the studied soils. Non-calcareous or slightly calcareous soils, on the other hand, contain low organic matter (<1.0%) (Table 1). Considering the first 20 cm of soil in the S1 and S2 regions, it was determined that studied soils organic carbon (C) content varied from 12.06 t C ha^{-1} and 16.05 t C ha^{-1}, respectively. The organic matter requirements of the Adıyaman soils are more evident when soil organic carbon of regions with similar climate and soil characteristics to Adıyaman reported to be over 71 t C ha^{-1} (15). The relationship between the low content of calcium in the pepper samples and it is absence in soils has a linear relation. However, while iron content of soils is within the medium to high range in the upper horizons (3,2-6.7 ppm) it is below adequate levels in plants. These deficiencies manifested a need for balanced nutrition by fertilization for pepper cultivation that will secure adequate uptake of all necessary elements.

In contrast to Ca and Fe contents, the high soil phosphorus level (8.5-9.9 kg.da-1) in both sample areas indicates that farmers do not consider the accumulated phosphorus in the soils (Table 1). Increasing the content of organic matter and zinc in the soil are expected to have a positive effect for enhancing the taste and nutritional properties of peppers (16).

The nutritional characteristics of fresh pepper grown in Adıyaman Region were found to be within normal values except for calcium and iron (Fe) (Table 2). Moreover, as Fe content of Adıyaman was below measurable value it is not presented in Table 2. The fresh harvesting of pepper ie before full maturation may cause lower energy values than the findings of some studies undertaken by Gebhardt and Thomas (17), Hanif *Et Al*. (18), Durucasu and Tokuşoglu (19) but it is still higher than USDA (6) reference values. As pepper matures i.e redness of the pepper advances the amount of carbohydrates goes up (Table 2) while the content of carbohydrate in green pepper is composed of glucose and fructose with low amounts of sucrose and starch (Table 2). Although soil P level is high the low phosphorus content in the plant samples is most probably due to insufficient application of organic and acidic (pH<7,0) fertilizers to soils that will enhance P uptake by plants (Table 1). Apart from this, studies soils clays are dominated by smectite and P fixation by smectite and kaolinite clays (20) is also considered as influencing phosphorus uptake by plants as it was stated by Chatterjee *et al*. (21). Authors suggested that phosphorus fixation was positively correlated with aluminum compounds as found in clay structure.

Compared with USDA (6) results, the amount of protein, fat, and fiber in Adıyaman pepper were high. Peppers' Ca, P and K minerals contents were similar to the previous studies (Table 2). When 100 g of pepper is consumed, 1.2% of energy, 1% carbohydrate, 2.66% of the protein, 0.8% of the calcium, 2.7% of the

Table 2. Comparison with of the chemical properties of some mineral contents of fresh peppers in Adiyaman with previous studies (100g).

	Results of this study	Gebhardt & Thomas (2002)	Guil Guerrero *et al.(*2006)	Hanif *et al.* (2006)	Durucasu & Tokuşoglu (2007)			USDA (2016)
Energy(kcal)	23.8±3.92	40	11.3±0.9	25±0.58	46.79±1.03			20
Water (g)	92.7±1.1	88	94.7±1.3	91.5				93.89
Protein (g)	1.6±0.4	2.2	0.70±0.06	1.3±0.02	0.99±0.03			0.86
Carbohydrate (g)	3±0.4	8.9	1.83±0.29	4.8±0.21	10.63±0.05			4.6
Fat (g)	0.6±0.08		0.19±0.06	0.2±0.01	0.33±0.08			0.2
Fibre (g)	2.6±0.7	1.6	1.04±0.11	1.2±0.01	2.73±0.10			1.7
						Park *et al.* (2006)	Roe *et al.* (2013)	
Calcium (mg)	8.2±2.1	17.7	10.8±1.2	12±0.2	-	10.4	7	10
Potassium (mg)	232.8±53.5	340	204±17	30±0.12	-	455.2	189	175
Phosphor (mg)	18.8±1.6	-	37.5±3.1	12±0.03	-	42.6	21	20

phosphorus are obtained when the amount of the daily requirement of macro nutrients and some minerals are taken into account (Table 2). In Adıyaman, especially during May and November which is the pepper-growing period, nutrients taken from three large size peppers (100g each) as a daily average consumption is quite high to be ignored. The fat-soluble vitamin E along with water-soluble C, B1, B2, B3, B6 and folate acid content of fresh peppers were higher than that of USDA (6) reference values except vitamin B1. In contrast, especially B9 (folate) vitamin was low than other studies (Table 3). Vitamins E, C, which are antioxidant vitamins, have higher concentrations according to the type of peppers (22). Changes for vitamins are observed depending on the maturation period. For example, the amount of folate, carotenoids, antioxidants in fresh red pepper are higher than green pepper (22). Folate is quite crucial for expecting mothers in Adıyaman, as crude birth rate is high in the region (21.8%), the inadequate folate nutrition during pregnancy may cause negative results for both mother (anemia) and baby (spina bifida).

Fresh pepper consumption was compared with the amount of energy and nutrient intake that should be taken daily (23). In this context, when 100 g fresh pepper is consumed in Adıyaman, 4.2% of daily vitamin B1 of males and 4.5% of females; 6.9% Vitamin B2 of males, 8.2% of females, 3.1% vitamin B3 of males and 3.6% of females, and the 20.8% of Vitamin B6, 4.4% of folate, 99.4% of vitamin C, along with 11.2% of Vitamin E of both sexes are met (23). The men and women vitamin C requirement was fully (ca 100%), and vitamin B6 (20.8%) and E (11.2%) were significantly supplied by fresh pepper consumption. However, these high values in fresh pepper can be reduced during cooking.

Vitamin C content of green pepper is higher than tomato and it is known that as pepper ripens it increases due to ascorbic acid increase (22). Also the vitamin C in red pepper may increase by 30% compared to green pepper according to maturation status (24). The ascorbic acid was lower in green pepper than red, or-

Table 3. Some vitamin contents in fresh pepper (100 g)

		Previous Studies		
Vitamins	**This study**	**Lower**	**Higher**	**USDA 2016**
B1 (Thiamin) (mg)	0.05±0,01	• 0.058 (EL-ARAB *et al.* 2004) • 0.06 mg (GOVİNDRAJAN 1986)	• 0.19 mg thiamine (KUMAR *et al.* 2006) • 0.25 mg (FAMUREWA *et al.* 2006)	0.057
B2 (Riboflavin)	0.09± 0.02	• 0.06 mg/100g (red pepper) • 0.02 mg/100g (yellow pepper) (ROE et al. 2013)	• 0.20 mg (FAMUREWA *et al.* 2006)	0.028
B3 (Niacin) (mg)	0.5±0.07	• 0.68mg/100g (EMMANUEL-IKPEME *et al.* 2014)	• 0.9 mg/100g FAO (1981)	0.48
B6 (Pridoksin) (mg)	0.27±0.03	• 0.27 mg (CHO *et al.* 2005) • 0.12mg (EMMANUEL-IKPEME *et al.* 2014) • 0.23mg (red pepper), 0.16mg/100g (yellow pepper) (ROE *et al.* 2013)		0.224
B9 –Folat- (µg)	17.6±2.14	-	• 20.7 mcg (PHİLLİPS et al. 2006) • 22 mcg (HEFNİ *et al.* 2010) • 30 mcg (ROE *et al.* 2013)	10
C (mg)	89.5±20.0	• 68.7 ± 2.9 (AYRANCI & TUNC 2004) • 52.2-163.1 (*FRARY et al.* 2008)	• 102±14- 268±22 (GUİL-GUERRERO *et al.* 2006) • 101.19 ± 3.761- 167.54 ± 2.828 (PERUCKA & MATERSKA. 2007) • 208.0±0.68- 72.0±0.64 (KUMAR&TATA. 2009)	80.4
E (mg)	1.68±0.96	• 0,31mg/100g (KİM et al. 2007) • 0.64 mg/100g (ROE *et al.* 2013)	• 4.6 mg/100g (MONGE-ROJAS & CAMPOS 2011) • 2,72-3,78mg/100g (KNECHT *et al.* 2015)	0.37

ange and yellow paprika. Feeding pepper with organic matter is also important in this context, as sheep manure and vermikompost application to tomatoes have a positive effect on their vitamin C content (25). The vitamin C content of studied peppers which are grown without supportive nutrients such as animal manure, and mainly harvested before ripening, was lower than the average of 167.54mg (26) and 208.0mg (27) even it is above the world average with 89.5mg. There are differences in chemical properties between sweet and hot pepper. Vitamin C in pepper is affected by its being hot or sweet. In this case, it can be said that the hotness of Adiyaman pepper is another reason for the high content of Vitamin C (89.5mg) than the USDA's (6) average value (80.4mg) (Table 3).

The average E vitamin content in Adıyaman green pepper was found to be approximately 4.5 times greater than the USDA-specified 0.37 mg value (Table 3). Vitamin E (α-Tocopherol) is the antioxidant that breaks down the most important lipophilic radical chain. For this reason, consumption of 1.68mg Vitamin E in Adıyaman is considered to be healthy manner which also meets the daily human requirement. However, in some studies the 4.6 mg/100g and 2.72 mg/100g (28,29) vitamin E were higher than the value of this study that can be attributed to low organic matter content of the Adıyaman soils. Because high soil organic matter (4%) affects antioxidant, phenol and similar contents positively in plants that are effective on plants vitamin E content (27).

When, the nutrient constituents of the fresh pepper and the traditionally oak wood cooked pepper (water, protein, carbohydrate, oil, fiber, phosphorus, calcium, potassium, B1, B2, B3, B6, C, E vitamins and folic acid) were compared, it has been determined that nutrient losses during cooking are not very high due to the short cooking time. The traditional cooking time (<12 minutes) in the wood fire most probably reduced nutrient losses. In previous studies, it has been reported that prolonged cooking period increased loss of antioxidants due to temperature, oxygen and light, however lower cooking temperatures is effective for the development of antioxidants (30). In cooked peppers, several chemical compounds, especially vitamin C, are reported to be reduced compared to fresh ones (31). It is stated that vitamin C loss may depend on the cooking time. However, this is not the case for vitamin E. This is supported by our findings that there was a significant loss of vitamin E by 41.1%, whereas loss of vitamin C was only 12.3%, which were lower values than anticipated (Table

Table 4. Comparison of the nutritional properties of peppers with fresh peppers, cooked by traditional cooking methods

Nutrient Constituents	Fresh Pepper	Roasted Pepper	Loss (%)
Energy	23.8±3.92	31±2.8	-
Protein (g)	1.6±0.4	1.3±0.5	18.8
Carbohydrate (g)	3±0.4	5±0.6	-
Fat (g)	0.6±0.08	0.6±0.2	-
Fibre (g)	2.6±0.7	2.9±0.6	-
Su (g)	92.7±1.1	92.5±0.9	0.2
Phosphor (mg/kg)	18.8±1.6	23±1.3	-
Calcium (mg/kg)	8.2±2.1	18±1.1	-
Potassium (mg/kg)	232.8±53.5	201±40.2	13.4
B1 vitamin (mg/100g)	0.05±0,01	0.045±0.01	10
B2 vitamin (mg/100g)	0.09± 0.02	0.0151±0.01	83.2
B3 vitamin (mg/100g)	0.5±0.07	0.231±0.03	53.8
B6 vitamin (mg/100g)	0.27±0.03	0.245±0.02	9.3
Folate (mg/100g)	17.6±2.14	14.8±1.9	15.9
C vitamin (mg/100g)	89.5±20.0	78.5±5.4	12.3
E vitamin (mg/100g)	1.68±0.96	0.99±0.3	41.1

4). Cooking in pressure cooker, microwave and steam causes a very small decrease in the ascorbic acid level but the boiling leads to high loss. Thus, it can be said that traditional pepper cooking, about 10 minutes, is suitable for prevention of nutrient loss. The least durable constituents of pepper were as follows retinol, vitamin C (most damage occurs in cooking and oxidation), folate (40% remains in cooking water) and thiamin (20-80% remains following cooking) (32). The amount of carbohydrate increased with the heat applied to the cooked pepper (66.6%) which is most probably due to the concentration effect caused by the water loss during cooking. In the cooked pepper, the vitamin B group vitamins, especially B2 and B3, are thought to be closely related to the water loss during cooking. Kimura and Itokawa (33) reported that the loss of potassium in water, especially in plants, varied between 55 and 55%. In this context, the 14% loss in this study can be considered to be within normal limits, and this is most likely the shortness of the cooking time as well as fast cooking in the stone oven.

Other than nutritional facts, bell pepper consumption in summer is a common tradition in Adıyaman although animal-based foods are more preferred by locals alike other parts of the world. However, bell pepper in Adıyaman is specially treated food for people. People prefer to have breakfast outside with friends at office or coffee houses with fresh pitta bread that they buy from commercial ovens that are found even at every district. Ovens in Adıyaman use naturally grown oak wood. Locals suggest that oak wood smoke gives unique taste and smell to pitta and foods. This may be like aging whiskey in oak barrels in Scotland since centuries as distillers think the same way as Adıyaman people suggest for oak smoke effect on foods and drinks. Oven owners do not ask any cooking fee if consumer buys fresh bread. Since every other day among friends a different one brings pepper to the breakfast table this makes possible for all the breakfasters to share the cost.

Free pepper cooking is also a kind of promotion that attracts people to bring food for cooking to stone ovens. So, other than cooking pepper people also ask baker to cook lunch and dinner meals with same way of paying ie buying fresh pitta. As the number of family members and friends are quite high in Adıyaman region, each consumer buys more than couple of pittas. This is then a good income for the baker. Having breakfast with friends act as a news exchange in Adıyaman, which tightens society relations.

Conclusions

The study revealed that in Adıyaman (Southeastern Anatolia Region, Turkey), a considerable amount of macro and micro nutrients are taken by pepper which daily consumption exceeds 300 gr in summers. It is determined that the vitamins and mineral (Potassium, B2, B9, C, vitamin E) contents of fresh pepper grown in Adıyaman were higher than international standards. Due to the short cooking time, ca 10 minutes, in oven that are fueled with oak wood, nutrient losses were found to be very low compared to many cooking methods. The most important loss was found for vitamin B in water-soluble vitamin groups, however the loss of vitamin C was found to be very low, unlike mentioned in the previous studies. Thus, cooking pepper in a oak wood-fired stone oven in the Adıyaman region revealed less nutrient losses compared to boiling and pressure steam cooking, which then can be recommended for healthy nutrition.

In Adıyaman region, pepper cultivation is mostly carried out on Luvisols and Cambisols that are non-calcareous or with low calcium carbonate content (<4%). Zinc and organic matter levels, which are likely to affect the quantity and quality of plant production in the soil, are below adequate levels (organic matter <1%, zinc <1ppm). Also Ca and Fe fertilization should be taken into account as plants' have low Ca and Fe contents. Pepper is a plant that first stands out with its flavor and antioxidant properties. Thus, improvement of soil properties will directly affect flavor and antioxidant content that will contribute to the improvement of the nutritional parameters mentioned above. For this reason, it is recommended to use controlled nitrogen fertilization to decrease the decomposition of the organic matter, which will help to increase the organic carbon content of the soils. Moreover, keeping the soil moisture content at the appropriate level by drip irrigation and application of all possible organic fertilizer sources such as harvest remnants to the pepper production areas will yield high quality pepper.

Adıyaman people still demands for oak wood-fired bell pepper cooking in local stone ovens. They said oak adds great taste to foods. The food cooking in district ovens create daily knowledge exchange within the society, as people prefer to have breakfast with friends rather than household members in summers. Thus, pepper consumption in Adıyaman should not be only considered as just eating something, but should be valued as a daily routine that people enjoy and share to participate.

Ultimately, it has been found that the Adıyaman pepper may continue to support local nutrition balance along with societal links by means of suitable cooking methods. However, soils cultivated for bell pepper requires attention for their nutrient management particularly increasing their organic carbon content is a primary concern.

Acknowledgement

This work was supported by Adiyaman University Scientific Research Projects Coordination Unit (ADYUBAP) via the project no TIOYOBAP/2013-0001.

References

1. Peirce L.C. Solanaceous crops. In: Vegetables: Characteristics, Production, and Marketing. New York: John Wiley, 1987; 309–332.
2. Sabbağ Ç. Akça E. Adıyaman Yerel Biberinin Besin ve Yetiştiği Toprak Özellikleri, GAP VII. Tarım Kongresi, 28 Nisan – 01 MAYIS 2015 Şanliurfa
3. Emmanuel-Ikpeme C., Henry P., Okiri O.A. (Comparative evaluation of the nutritional, phytochemical and microbiological quality of three pepper varieties. Journal Food Nutrition Sciences 2014; 2(3): 74-80.
4. Suchankova M., Kapounova Z., Dofkova M., Ruprich J., Blahova J., Kouřilová I. Selected fruits and vegetables: comparison of nutritional value and affordability. Czech Journal of Food Sciences 2015; 33(3), 242-246.
5. IUSS Working Group WRB World reference base for soil resources 2014, update 2015.» International soil classification system for naming soils and creating legends for soil maps. 2015, FAO, Rome.
6. USDA National Nutrient Database for Standard Reference Release 27, Basic Report 11333, Peppers, sweet, green, raw, Report Date: July 10, 2016.
7. U.S. Salinity Laboratory Staff. Diagnosis and improvement of saline and alkali soils. USDA Handb. 60. U.S. Gov. Print. Office, 1954, Washington, DC.
8. Olsen S.R., Sommers L.E. Phosphorus. In: Page AL, et al (eds), Methods of Soil Analysis, Part 2, 2nd edn, Agron Monogr 9. ASA and ASSA, Madison WI, 1982; 403–430.
9. Goldberg S., Sposito G. A chemical model of phosphate adsorption by soils: I. Reference oxide minerals Soil Sci. Soil Science Society of America Journal, 48, 1984; 772-778
10. Thomas G.W. Soil pH and soil acidity. In: D.L. Sparks et al. (Eds). Soil Sci. Soc. Am., 1996; 475–490, Madison, WI.
11. WHO/FAO/UNU Report: Energy and protein Requirement: WHO technical report series No.724: 220(WHO Geneva); 1985
12. AOAC Official methods of analysis of AOAC International. (W Horwitz and G.W. Latimer eds). 18th ed. 2011; Gaithersburg.
13. Krejcová A., Návesník J., Jicínská J., Cernohorsky T. An elemental analysis of conventionally, organically and self-grown carrots. Food chemistry 2016; 192: 242-249.
14. Fontanaz, P., T. Kılınç O. Heudio. HPLC-UV determination of total vitamin C in a wide range of fortified food products. Food Chemistry 2006; 94: 626-631.
15. Brahim N., Ibrahim H., Hatira A. Tunisian Soil Organic Carbon Stock–Spatial and Vertical Variation. Procedia Engineering, 2014; 69: 1549-1555.
16. Zayed M.S., Hassanein M.K.K., Esa N.H., Abdallah M.M.F. Productivity of pepper crop (Capsicum annuum L.) as affected by organic fertilizer, soil solarization, and endomycorrhizae. Annals of Agricultural Sciences, 2013; 58(2).
17. Gebhardt S.E., Thomas R. G. Nutritive Value of Foods. USDA Agricultural Research Services. Home and Garden Bulletin Number:72, Washington, USA. 2002; 97.
18. Hanif R., Iqbal Z., Iqbal M., Hanif S., Rasheed M. Use of vegetables as nutritional food: role in human health. Journal of Agricultural and Biological Science 2006; 1(1): 18-20.
19. Durucasu, I. Tokusoglu, O. Effect of grilling on luteolin (3, 4, 5, 7-tetrahydroxyflavone) content in sweet green bell pepper (Capsicum annum). Pakistan Journal of Biological Sciences 2007;10:3410–3414.
20. GDRS Detailed Soil Survey of Adıyaman - Besni - Keysun and Kızılin Irrigation Plains. Technical Report, General Directorate of Rural Services (GDRS), Ministry of Ruraral Affairs and Agriculture. Ankara, 1996; 285 (in Turkish).
21. Chatterjee D., Datta S.C., Manjaiah K.M. Fractions, uptake and fixation capacity of phosphorus and potassium in three contrasting soil orders. Journal of Soil Science and Plant Nutrition 2014; 14(3): 640-656.
22. Marín A., Ferreres F., Tomás-Barberán F.A., Gil M.I. Characterization and quantitation of antioxidant constituents of sweet pepper (Capsicum annuum L.). Journal of Agricultural and Food Chemistry 2004; 52: 3861–3869.
23. Turkey Specific Nutrition Guide. Ministry of Health. T.C. Directorate of Basic Health Services. University of Hacettepe, Ankara (in Turkish).
24. Ghasemnezhad M., Sherafati M., Payvast G.A. Variation

in phenolic compounds, ascorbic acid and antioxidant activity of five coloured bell pepper (Capsicum annum) fruits at two different harvest times. Journal of functional foods 2011; 3(1): 44-49.
25. Gutiérrez-Miceli F.A., Santiago-Borraz J., Molina J. A.M., Nafate C.C., Abud-Archila M., Llaven M.A.O., Dendooven L. Vermicompost as a soil supplement to improve growth, yield and fruit quality of tomato (Lycopersicum esculentum). Bioresource Technology 2007; 98(15): 2781-2786.
26. Perucka I., Materska M. Antioxidant vitamin contents of Capsicum annuum fruit extracts as affected by processing and varietal factors. Acta Scientiarum Polonorum Technologia Alimentaria, 2007; 6(4):67-73.
27. Kumar O.A., Tata S. S. Ascorbic acid contents in chili peppers (Capsicum L.). Notulae Scientia Biologicae, 2009; 1(1), 50.
28. Monge-Rojas R., Campos H. Tocopherol and carotenoid content of foods commonly consumed in Costa Rica. Journal of Food Composition and Analysis, 2011; 24(2): 202-216.
29. Knecht K., Sandfuchs K., Kulling S. E., Bunzel D. Tocopherol and tocotrienol analysis in raw and cooked vegetables: a validated method with emphasis on sample preparation. Food chemistry, 2015; 169:20-27.
30. Song J., Liu C., Li D., Meng L. Effect of Cooking Methods on Total Phenolic and Carotenoid Amounts and DPPH Radical Scavenging Activity of Fresh and Frozen Sweet Corn (Zea mays) Kernels, Czech Journal Food Sciences, 2013; 31, 6: 607–612.
31. Barros A.I., Nunes F.M., Gonçalves B., Bennett R.N., Silva, A.P. Effect of cooking on total vitamin C contents and antioxidant activity of sweet chestnuts (Castanea sativa Mill.). Food chemistry, 2011; 128(1):165-172.
32. Lešková E., Kubíková J., Kováčiková E., Košická M., Porubská J., Holčíková K. Vitamin losses: Retention during heat treatment and continual changes expressed by mathematical models. Journal of Food Composition and analysis, 2006;19(4): 252-276.
33. Kimura M., Itokawa Y. Cooking losses of minerals in foods and its nutritional significance. Journal of Nutritional Science and Vitaminology, 36(4-SupplementI): 1990; 25-33.

Correspondence:
Çiğdem Sabbağ
Associate Professor, Adıyaman University, School of Tourism, 02040, Adıyaman, Turkey
E-mail: csabbag@adiyaman.edu.tr