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# INVESTIGATION OF SOME WATER SOLUBLE PARAMETERS IN APRICOT FRUIT OF DIFFERENT VARIETIES CULTIVATED

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## ABSTRACT
In this study, the amounts of reduced form of glutathione (GSH), oxidized form of glutathione (GSSG) and various B vitamins particularly, thiamine hydrochloride (vitamin B1), riboflavin (vitamin B2), nicotinic acid (vitamin B3), pyridoxine hydrochloride (vitamin B6) and folic acid (vitamin B9) in fresh ripe apricot fruits of six different varieties were determined by High Performance Liquid Chromatography(HPLC). It was observed that GSH, GSSG, vitamin B1, vitamin B2, vitamin B3, vitamin B6 and vitamin B9 levels were between 914.70±24.10 – 82.56±5.92 μg/g; 35.28±2.73 – 17.16±2.05 μg/g, 0.49±0.08 - 1.02±0.13 μg/g, 1.56±0.14 - 4.48±0.46 μg/g, 16.10±2.46 5.40±0.52 μg/g, 23.85±2.90 - 7.86±0.58 μg/g and 8.84±0.86 - 3.04±0.29 μg/g, respectively. The Hudayı variety was rich in GSH, GSGH, vitamin B1 and B2, Kabaaşı variety was rich in Vitamin B3 and B6 and Hacıhaliloğlu variety was rich in vitamin B9.
**Keywords:** Apricot, glutathione, vitamins B and HPLC

# FARKLI KAYISI ÇEŞİTLERİNDE SUDA ÇÖZÜNÜR BAZI PARAMETRELERİN ARAŞTIRILMASI

## ÖZ
Bu çalışmada taze ve olgun altı farklı kayısı çeşidinin redükte glutatyon (GSH), okside glutatyon (GSSG) ile çeşitli B vitamini özellikle tiamin hidroklorür (B1), riboflavin (B2), Nikotinik asit (B3) piridoksin hidroklorür (B6) ve folik asit (B9) içerikleri Yüksek Performanslı Sıvı Kromatografisi (HPLC) kullanılarak belirlenmiştir. GSH, GSSG, B1, B2, B3, B6 ve B9 vitaminlerinin içeriği sırasıyla 914.70±24.10 – 82.56±5.92 μg/g; 35.28±2.73 – 17.16±2.05 mg/g, 0.49±0.08 - 1.02±0.13 μg.g-1, 1.56±0.14 - 4.48±0.46 μg.g-1, 16.10±2.46 5.40±0.52 μg/g, 23.85±2.90 - 7.86±0.58 μg/g ve 8.84±0.86 - 3.04±0.29 μg/g arasında olduğu gözlenmiştir. Hudayı çeşidinin GSH, GSSG, B1 ve B2 vitamini, Kabaaşı çeşidinin de B3 ve B6 vitaminleri ve Hacıhaliloğlunun B9 vitamini bakımından zengin olduğu görülmüştür.
**Anahtar kelimeler:** Kayısı, Glutatyon, B Vitaminleri ve HPLC

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## INTRODUCTION

Apricot (*Prunus armeniaca L.*) is rich by important minerals such as potassium, sodium, phosphorous and nutrients like vitamins and β-carotene. Climate conditions, altitude and soil composition have great effect on the yield, fruit quality and ripening times (Uslu et al., 1995). The variety of apricot is an important parameter on the amount of the nutrient and mineral contents, some varieties are especially suitable for drying to obtain high calorific values, vitamins and mineral-rich products. The level of protein, oil, carbohydrate, moisture, ash, cellulose and dry matter may change with the kind of apricot variety (Pala et al., 1994).

Despite wide cultivation in many parts of the world, apricot cultivation in Malatya-Elazig region of eastern Turkey is favorable in terms of climatic and geographical factors. According to recent statistics, more than half of Turkey's 800,000 t of fresh fruit and almost all sulfur and sun dried apricot production originate from this region. This figure is about 10% of the world fresh apricot and 80% of the world dried apricot production (Asma, 2000; SIS, 1998). As with many other fruits, the nutritional importance of this fruit was only recently realized and since then, numerous investigations have been carried out on both fresh and dried forms, focusing mainly on the carbohydrate, amino acid and mineral and vitamin contents (Belloso & Barriobero, 2001; Watt & Merrill, 1978). A study by Paunovic (1985) showed that 100 g of dried apricot contained 5.0 g protein, 0.5 g fat, 66.5 g carbohydrate, 108 mg phosphorus, 979 mg potassium and 12 mg vitamin C. There is data on mineral and vitamin contents of apricots in food composition charts but the level of these minerals and vitamins in the fresh and dried fruits have not been related (Belloso & Barriobero 2001; Watt & Merrill 1978). Although, it is reported that some apricot varieties are rich in terms of vitamins B, there is not much information about glutathione content in the literature (Gundogdu et al., 2013). To our knowledge, there is no work in the literature reporting the content of reduced and oxidized glutathione (GSH and GSSG) in fresh apricot varieties. Therefore, the aim of this study was to determine the amount of GSH, GSSG, thiamine hydrochloride (vitamin B1), riboflavin (vitamin B2), nicotinic acid (vitamin B3), pyridoxine hydrochloride (vitamin B6) and folic acid (vitamin B9) in the fresh apricot fruit of different varieties cultivated in Malatya-Elazığ region of eastern Turkey.

## MATERIALS AND METHODS

Apricot fruits from five common cultivars and a wild type (Hudayi) were collected from Malatya-Elazığ region and used for the study. Fresh apricots of similar ripening periods were collected by random sampling. The varieties selected for this study are known by their local names: Parlak Soğanci, Hasanbey, Hacıhaliloğlu, Kabaaşi, Şam and Hudayı which were abbreviated as PS, HB, HH, KA, SA and HU, respectively. The fruits were covered with aluminum foil and transported to the laboratory and immediately subjected to analysis as it is known that maturity level is one of the major factors determining the compositional quality of fruits and vegetables (Lee & Kader, 2000). Experiments were conducted in parallel for the 6 varieties and each test was triplicated. The results are reported as arithmetic mean of the three replicates and standard error.

### Determination of GSH, GSSG, vitamin B1, vitamin B2, vitamin B3, vitamin B6 and vitamin B9 levels in fresh fruit

Fresh apricot fruits samples were mashed in a homogenizer and 2.0 g of homogenate paste per sample were taken for the extraction of reduced and oxidized glutathione. 1.0 mL aliquot of 1.0 mol/L $HClO_4$ solution was added to the homogenate to precipitate the proteins. Total volumes were made up to 4.0 mL by adding distilled water. The mixture was centrifuged at 4000 rpm for 5.0 min at 4°C.

The supernatant was filtered by Whatman No. 1 paper and the amount of GSH and GSSG was determined using the method proposed by Dawes and Dawes (2000). A SGE Walkosil II 5Cl8 RS packed column (150 mm×4.6 mm ID, 5μm) was used. The mobile phase was 50 mM $NaClO_4$ in 0.1% $H_3PO_4$ solution with pH 4.0 at 1.0 mL/min flow rate with detection at 215 nm. Vitamin B1,

vitamin B2, vitamin B3, vitamin B6 and vitamin B9 levels were determined using the method proposed by Amidzic et al. (2005) and Ivanovic et al. (1999).

Supelcosil LC-18-DB column (150 mm x 4.6 mm ID, 5 μm) was used for the determination of vitamins. The experiments were conducted at room temperature for all vitamins. A methanol-5mM heptanesulphonic acid sodium salt in 0.1% triethylamine (25:75 v/v) mixture was used as mobile phase. The pH of the mobile phase was adjusted with orthophosphoric acid to 2.8. The flow rate was set at 0.7 mL/min and the injection volume was 20 μL. Vitamins B1, B2 and B3 were detected at 260 nm while vitamins B6 and B9 were detected at 290 nm. All prepared mobile phases were degassed with an ultrasonic bath. Each run was repeated three times to check repeatability. HPLC separations were accomplished at room temperature with a Cecil HPLC system (Series 1100) consisting of a 20 μL sample injection valve (Cotati 7125 CA, USA), a ultra-violet (UV) spectrophotometric detector (Cecil 68174, UK) and an integrator (HP 3395A, China).

The chemicals and reagents used in this work were of analytical grade and purchased from Sigma Chemical Co. (Darmstadt, Germany). All glassware was acid washed and rinsed with doubly distilled deionized water (dd$H_2O$).

**Statistical analysis**

Statistical analysis was performed using SPSS 17.0 for Windows software (SPSS Inc. Chicago, IL, USA). Analysis was carried for the six varieties under investigation, and the results are presented as the mean value ± standard error (S.E.).

## RESULTS AND DISCUSSION

Table 1 summarizes all results obtained for the six varieties under investigation. Glutathione (GSH) is a tripeptide (γ-glutamyl-cysteinyl-glycine) which forms the largest pool of non-protein thiols in cells and it is an important intracellular antioxidant. Under conditions of oxidative stress, GSH reacts either as an electron donor to neutralize hydrogen peroxides and lipoperoxides or as a direct free radical scavenger (Meister, 1994; Shan et al., 1990). Glutathione is also the most abundant nonenzymatic antioxidant in live cells where it plays an important role against oxidative stress-induced cell injury (Hayes & McLellan, 1999). Glutathione is also related to the sequestration of xenobiotics and heavy metals. Furthermore, glutathione is an essential component of the cellular antioxidative defense system which keeps Reactive Oxygen Species (ROS) under control (Noctor & Foyer, 1998). Antioxidative defense and redox reactions play a major role in the acclimation of plants to their environment which make glutathione a suitable candidate as a stress marker (Tausz et al., 2004).

Table 1. The reduced and oxidised glutathione and vitamin B contents of fresh apricot fruits.

| Parameters (μg/g) | Parlak Soğancı (PS) | Hasanbey (HB) | Hacıhaliloğlu (HH) | Kabaaşı (KA) | Şam (SA) | Hudayı (HU) |
|---|---|---|---|---|---|---|
| GSH | 110.45 ± 7.14 | 82.56 ± 5.92 | 216.34 ± 9.85 | 132.08 ± 8.65 | 362.54 ± 11.96 | 914.70 ± 24.10 |
| GSSG | 20.24 ± 1.86 | 21.05 ± 1.64 | 17.16 ± 2.05 | 20.5 ± 1.90 | 21.5 ± 1.98 | 35.28 ± 2.73 |
| Vitamin B1 | 0.75 ± 0.12 | 0.82 ± 0.13 | 0.78 ± 0.11 | 0.57 ± 0.09 | 049 ± 0.08 | 1.02 ± 0.13 |
| Vitamin B2 | 2.56 ± 0.27 | 2.14 ± 0.22 | 1.75 ± 0.18 | 1.90 ± 0.20 | 1.56 ± 0.14 | 4.48 ± 0.46 |
| Vitamin B3 | 15.67 ± 2.11 | 5.40 ± 0.52 | 12.71 ± 1.86 | 16.10 ± 2.46 | 15.40 ± 2.00 | 14.25 ± 2.04 |
| Vitamin B6 | 7.86 ± 0.58 | 14.10 ± 1.49 | 13.52 ± 1.22 | 23.85 ± 2.90 | 15.70 ± 1.52 | 18.70 ± 2.25 |
| Vitamin B9 | 5.50 ± 0.62 | 3.04 ± 0.29 | 8.84 ± 0.86 | 5.40 ± 0.50 | 3.88 ± 0.35 | 3.19 ± 0.32 |
| GSH/GSSG | 5.46 | 3.92 | 12.61 | 6.44 | 16.86 | 25.93 |

Table 1 shows GSH, GSSG and vitamins B levels of the six apricot varieties under consideration. It is clear that among the six apricot varieties, HU is the richest variety in terms of GSH and GSSG. The GSH and GSGH content of HU is followed by SA and HH variety. Uguralp et al. (2012) found that GSH levels of rat tissues induced to cold restraint stress decreased. Upon administration of dry apricots to these rats, GSH levels in the stomach and intestine tissues increased. Therefore, this is an indication that apricots are rich in terms of glutathione.

The glutathione redox level depends on the ratio of reduced and oxidized glutathione (GSH/GSSG) (Karatas et al., 2009). The GSH / GSSG ratio at the basal level is high while this rate is decreased in many oxidative stress models (Kocsy et al., 2001). The GSH/GSSG ratios for apricot varieties are calculated as 25.93 for HU, 16.86 for SA, 12.61 for HH, 6.44 for KA, 5.46 for PS and 3.92 for HB(Table 1). Thus, the HU variety had the lowest while HB variety had the highest oxidative stress.

In literature, the term B-complex refers to all known essential water soluble vitamins except for vitamin C. Each member of the B-complex has a unique structure and performs unique functions in the human body (Papadoyanni, 1990). B-complex vitamins are effective supplements for neural and digestive system and commonly used for wound healing. They take part in biochemical reactions as coenzymes (Berg et al., 2002).

It is reported that vitamins B1, B2 and B3 take an important role in energy metabolism. Vitamin B1 takes role in the conversion of carbohydrates to glucose, while vitamin B2 takes role in the conversion of carbohydrates, proteins and fatty oils to energy. Vitamin B3 is the principal vitamin that cures the pellagra and regulates blood flow. Vitamin B6 and B9 play important role in protein, amino acids and carbohydrate metabolism and in the formation of red blood cells (Combs, 1992; Steven & Zeisel, 2000).

From the results given in Table 1, it is seen that HU variety is richer in terms of vitamins B1 and B2 content compared to the rest of the varieties considered. However, the KA variety has the highest vitamin B3 and B6 content while HH variety is seen to have the highest vitamin B9 content. The data given in Table 1 on B vitamins (B1, B2, B3, B6 and B9) level of all apricot varieties are in agreement with the literature (Ercisli et al., 1999).

The results reported in this work indicate that fresh apricots are a good source of glutathione and B vitamins. But the difference in the amount of glutathione and vitamins B content is due to the type of the fruit variety.

## CONCLUSION

Although there are differences between the varieties GSH and vitamins B content, the fresh apricot fruit is rich in terms of GSH and vitamins B. Therefore, apricots may be considered as an essential fruit for a healthy diet. The information on the glutathione and vitamins B contents of apricots will help in getting the attention of researchers to the subject.

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