

## Research Article

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### Antioxidant Activity and Altitude-Analysis of Changes in Fruits from Fruits and Raspberries

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#### Abstract

Strawberries and raspberries are perennials of the Rosaceae family. They can be wild or cultivated. Strawberry fruits are high in carbohydrates and vitamin C, low in calories and fats. Raspberries contain flavonoids, carotene, tannins, vitamin C and P, organic acids, vitamins from the B group, minerals, formic acid, phosphorus, carbohydrates, magnesium, potassium and calcium oxides, iron compounds, carotene, malic and salicylic acid.

**Purpose:** Determine the influence of altitude on some chemical characteristics of strawberries (Kama type) and raspberries (Heritage type).

Used Research Methods:

- Systematic approach and critical analysis of the accessible scientific periodicals.
- Spectrophotometric method for determination of absorption and standard line in gallic acid.
- DPPH method for determining antioxidant activity (radical detecting activity).

Results: Raspberry pH ranges from 2.17 to 2.99; Strawberry pH is in the range of 3.50 to 4.00. The antioxidant activity in strawberries ranges from 901 to 4193 m mole TE / 100 ml juice, and in raspberries from 383 to 2010 m mole TE / 100 ml juice.

#### Conclusions:

- The antioxidant activity of the fruits is not pH dependent.
- Antioxidant activity increases with altitude.

**Keywords:** Antioxidant Activity; Raspberries; Strawberries

#### Introduction

Strawberries and raspberries are perennials of the Rosaceae family. They can be wild or cultivated [1,2]. Strawberry fruits are high in carbohydrates and vitamin C, low in calories and fats. Strawberries are a rich source of anthocyanins, ellagitannins,

flavonoids, terpenoids, as well as phenolic and ellagic acids – all phytonutrients that work together to have a strong anti-inflammatory effect. Minerals such as copper, fluoride, iron and iodine are in abundance [3-5].

The home of the strawberry is the United States. Today it is widespread in Europe and parts of Asia. In Bulgaria, it is grown in the garden of almost every home. The fruit, root and leaves of the

plant are used [6-8].

Chemical composition of strawberries: 8-10% sugars (fructose and glucose predominate); 1- 1.5% acidity (contains citric, malic, salicylic acids); ellagic acid; minerals - (calcium, potassium, magnesium, phosphorus, sodium, copper, manganese, chlorine, fluorine, iron); vitamins of group B - B1, B2, B5, B9, vitamins PP, C, E, P, K; carotene; pectic substances; folate; anthocyanin; kaempferol and other flavonoids; anthocyanins and pterostilbene [9-12].

Medicinal properties and applications of strawberries: Immunostimulatory, anti-hemorrhagic, anticancer, anti-inflammatory, anti-edema, astringent, antimicrobial, antiviral, enhances heart rate, dilates peripheral blood vessels, lowers blood pressure, strengthens uterine contractions, increases appetite, improves digestion, strengthens teeth, gives fresh face complexion, purifies blood [11,12].

Raspberries are grown in areas with moderate climates, mainly in Europe and the US. Wild raspberries are found in Europe, Asia, South America, in moderate, tropical and subtropical climates [13,14]. The fruit, root and leaves of the plant are used.

Chemical composition of raspberries: Flavonoids, carotene, tannins, vitamin C and P, organic acids, vitamins from the B group, minerals, formic acid, phosphorus, carbohydrates, magnesium, potassium and calcium oxides, iron compounds, carotene, malic and salicylic acid [14-18].

Medicinal properties and applications of raspberries: The leaves are used for pain in the stomach and intestines, diarrhea, and blood sputum. The roots are used for the preparation of: a decoction to treat colds, severe and prolonged menstruation, flu and ascites. When the leaves are infused they are good for inflamed gums and sore throat [19-23].

Raspberry fruits are one of the strongest natural antioxidants because of the high content of ellagic acid and vitamin C. They improve digestion and reduce fever. This is due to the content of salicylic acid in them. Recent studies have shown that raspberries act against cancer and stop the spread of tumor formation in the body [22-27].

Like the authors P.R. Venskutonis, A. Dvaranauskaite and J. Labokas, we also have conducted studies on the antioxidant properties of strawberries (Kama type) and raspberries (Heritage type) both grown at different altitudes.

**Purpose:** Determine the influence of altitude on some chemical characteristics of strawberries (Kama type) and raspberries (Heritage type).

## Material and Methods

**Objective of The Study:** Basic chemical characteristics of strawberries (Kama type) and raspberries (Heritage type) grown at different altitudes. The strawberries and raspberries have been grown in the following regions:

- The city of Plovdiv - 168 meters above the sea level.
- Brestnik village - 320 meters above the sea level.
- The city of Bratsigovo - 599 meters above the sea level.
- The city of Batak - 1036 meters above the sea level.

**Period of Study:** May-September 2019.

**Place of Study:** Laboratory of the University of Food Technology Plovdiv and Laboratory of Pharmaceutical Analysis of the Medical University of Plovdiv.

## Used Research Methods

- Systematic approach and critical analysis of the accessible scientific periodicals.
- Spectrophotometric method for determination of absorption and standard line in gallic acid.
- DPPH method for determining antioxidant activity (radical detecting activity).

## Equipment Used

1. Analytical scales KERN ABJ 220-4M.
2. Camspec M107 Spectrophotometer, UK; pH meter.
3. Standardized pH meter with pH 4.0 and 7.0 standard buffer solutions (WTW inoLab pH 7110, Germany).
4. Standardized pH meter with pH 4.0 and 7.0 standard buffer solutions and the Denver Instrument Ultra Basic pH meter.

## Reagents and Solutions

- To determine antioxidant activity by DPPH method.
- M DPPH Reagent: 10 mg of DPPH (2,2-Diphenyl-1-picrylhydrazyl) are dissolved in 250 ml of methanol.

## Sample Preparation

The strawberries and raspberries fruits are cut into pieces and blended into a homogeneous mass. 8 grams of the homogenized fruit mass are weighed (analytical scales KERN ABJ 220-4M).

The sample quantity and the ethanol are transferred into a 50 ml measuring flask and the volume is brought to the mark. The sample stays at room temperature for 15 minutes.

### Progress of The Analysis for The Determination of Antioxidant Activity (Radical Detecting Activity) By The DPPH Method

2.85 ml of 0.1 M DPPH solution is put into a ditch and then 0.15 ml of sample is added. The same reagents are prepared for the control check but a solvent is placed instead of a sample. The prepared samples are kept at 37°C for 15 minutes. The adsorption of the sample is measured spectrophotometrically against the control (methanol solvent) at a wavelength  $\lambda = 517$  nm (Camspec M107, UK). Antioxidant activity is recorded by a pre-established standard line for Trolox® (Sigma).

### Estimates

$$I, \% = (A \text{ control check} - A \text{ sample}) / (A \text{ sample}) * 100$$

$$C, \text{ m mol TE / ml} = 102.06. I\% + 0.7954$$

$$m \text{ mol TE / g s.t} = (V \times C) / M$$

Where: C: Concentration, mM TE - TROLOX equivalents; I: Inhibition Rate; A: Absorption; M: Weight of The Sample, (gr); V: Volume of The Sample, (100 ml)

### Progress of The Analysis for pH Determination

30 ml of the strawberry and raspberry samples are put in 50 ml glass beakers. The pH meter electrode is dipped in and the pH value is determined.

### Results and discussion

The results presented are the arithmetic average values from at least three parallel studies. Due to the great interest in the chemical properties and biological benefits of strawberries and raspberries, we focused on studying their pH and antioxidant activity (Table 1).

Altitude, m	pH of raspberries	pH on strawberries
168	2.89	3.64
334	2.17	3.60
591	2.75	3.82
1014	2.99	3.55

**Table 1:** Altitude and pH values.

Raspberry pH ranges from 2.17 to 2.99. Strawberry pH is in the range of 3.50 to 4.00. Besides red, raspberries can be black or golden. Raspberry consumption is associated with a great variety of health benefits - a reduced risk of cardiovascular disease, diabetes

and cancer. The phenolic compounds, which raspberries contain, such as flavonoids, phenolic acids, stilbenes and procyandins work together synergistically [1]. The Red raspberry (*Rubus idaeus L.*) is an economically important plant with a great capacity because of its ability to neutralize free radicals. [27]

To analyze the antioxidant activity of the in vitro samples, as in [19], we use the DPPH method. The Journal of Functional Foods has published an article by Japanese scientists in which it has been proven that strawberries are beneficial for treating skin allergic reactions and also have anti-inflammatory, antioxidant and anti-cancer effects. Akira Ivamato of Kyushu University and his colleagues have conducted an experiment with mice suffering from a disease similar to atopic dermatitis in humans. The rodents were injected with a substance, containing 18 milligrams of strawberry essence for 14 weeks.

The antioxidant activity determined by the DPPH method and its dependence on altitude is presented in Table 2.

Altitude, m	Antioxidant activity of raspberries (m mole TE / 100 ml juice)	Antioxidant activity of strawberries (m mole TE / 100 ml juice)
168	382.87 ± 30	901.12 ± 20
334	461.32 ± 30	1080.19 ± 20
591	489.63 ± 26	2253.11 ± 0.20
1014	2010.53 ± 10.28	4193.41 ± 0.20

**Table 2:** Dependence of Antioxidant activity on altitude.

As seen in Table 2, with the increase in altitude, the antioxidant activity also increases. The activity goes from 383 at an altitude of 168 m to 2011 at 1014 m. With an altitude increase of about 6 times, the antioxidant activity of raspberries increases 5.25 times. As with the raspberries, when the altitude increases the antioxidant activity does also but for the strawberries the increase is 4.65 times. In considered cases, the antioxidant activity of raspberries is higher than that of strawberries.

### Conclusions

The obtained results strongly indicate that:

- The pH level of the tested fruit samples does not depend on the altitude of cultivation.
- The antioxidant activity of the fruits is not pH dependent.
- Antioxidant activity increases with altitude.

- The study shows that at the considered altitudes, the antioxidant activity of strawberries is always greater than that of raspberries.

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