

## THE ESTIMATION OF DEPENDENCY OF FRESH BERRIES PHYSICO-CHEMICAL PROPERTIES ON STORAGE AND PROCESSING CONDITIONS

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### Abstract

*In this article are elucidated the results of the experimental research connected with the oxido-reducing state of strawberries and raspberries in different level of ripeness. Here are presented: physico-chemical composition of the investigated samples, dry matter content, pH, anthocyanin content, polyphenols, ascorbic acid and K coefficient, which evidence oxido-reducing state of berries. It has been studied, also, the oxido-reducing state of this berries during storage condition.*

*It was found that berries are rich in bioantioxidants. From physico-chemical point of view these fruits are in a reduced state, characterized by high values of index K. Biological value expressed by the oxidation-reducing state of berries depends on the ripeness level. Samples spectral analysis showed that depreciation of strawberries aspect and appearance of brown color is determined by anthocyanins and polyphenols degradation and brown compounds formation.*

Keywords: bioantioxidant, anthocyanins, ascorbic acid, reducing state coefficient, degree of ripeness.

## 1. INTRODUCTION

Strawberries are delicious fruits, with a good smell and taste, nice appearance. That is why they are requested fresh. Their sensory properties are determined by the presence of phenol substances and anthocyanins. Their nutritional value is established by the presence of phenol substacnes, anthocyanins, L-hidroascorbic acid, vitamins, macro- and micronutrients. Strawberries are perishable and under the action of peroxidase enzymes that contribute to the appearance of brown compounds and the loss of smell, they support permanent changes of phenol substances (their oxidation) [2,3,4]. This paper is about the results of experimental research of strawberries chemical composition, the study of the process of fruits breathing, optical density change at different fractions of strawberries: liquid and solid fraction.

## 2. MATERIALS AND METHODS

As the object of study served fresh strawberries and raspberries, acquired from trading system. For the determination of physico-chemical

indices standard methods were applied. Have been evaluated following indicators:

water soluble substances content, titrating acidity, active acidity, pH; content of L-hydro-ascorbic acid, total polyphenol content (by Folin-Ciocalteu method), determination of anthocyanins (spectrophotometric method), oxido-reducing state of the samples [4,5]. The oxido-reducing state of the samples was determined through potentiometric method and expressed by oxido-reducing state index (K) [4].

## 3. RESULTS AND DISCUSSION

In Table 1 are presented physico-chemical indices of strawberries. Experimental data testifies that the chemical composition of strawberries is highly variable.

**Table 1. Physico-chemical indices of strawberries**

Physico-chemical indices	Strawberry	Raspberries
HS, %	6,5 ... 12,4	7,0 ...15,8
pH, %	3,10 ... 3,75	3,1 ... 3,5
Titrating acidity, %	0,75 ... 1,25	0,72 ...1,47
Redox potential, mV	202 ... 230	225 ...240

Along with physico-chemical indices were evaluated and the content of antioxidants: L-hydro-ascorbic acid, anthocyanins and total polyphenols. Results of the estimates are included in the Table 2. The content of antioxidant in the studied fruits was highly variable, which determined that the reducing state of the samples was variable. For strawberries the K coefficient was estimated within 8,52...19,6 (mg AA/g SU), and for raspberries - 2,2 ... 5,31 (mg AA/g SU).

**Table 2. Antioxidant content of strawberries and raspberries**

Antioxidant content, mg/100 g product	Strawberry	Raspberries
Total polyphenols	148...456	205... 331
Total anthocyanins	17 ... 62	22... 46
L-hidroascorbic acid	31 ... 57	29 ... 53
Oxido-reducing state, K, mg AA/g HS	8 ...20	2 ... 5

Having high water content, strawberries have reduced hardness, soft tissue, thin skin, low resistance to shocks and stresses. They are very susceptible of getting a brown aspect, which then lead to decay. Being too perishable, they quickly lose their quality and nutritional value (biologically active substance decreases) due to biodegradation processes, characteristic of the breathing process (biochemically processes of oxidation-reduction). In order to maintain the quality of biological active substances is recommended to keep strawberries at low temperatures. Maintenance of the quality of fresh fruit is achieved by reducing the intensity of sweating process by reducing the temperature and oxygen access [1,2,3,6]. Strawberries breath intensity was estimated by mg CO<sub>2</sub> consumption, at different temperatures: 0, 5, 10, 15 and 20°C. In Table 2 experimental data are concerned.

Obtained data evidence that as the storage temperature is higher, the mg CO<sub>2</sub> consumption is higher, so the process of breathing is more intense. So, optimal storage conditions of strawberries are at temperature of

2 ± 1 ° C, 90-95% humidity, the shelf life of 2 - days. Reducing access of oxygen increased the duration of storing up to 4-7 days, depending on strawberries maturity level. Biochemical oxidation reactions of phenol substances are catalyzed by enzymes: phenoloxidase, peroxidase, catalase. The highest activity manifested polyphenoloxidase.

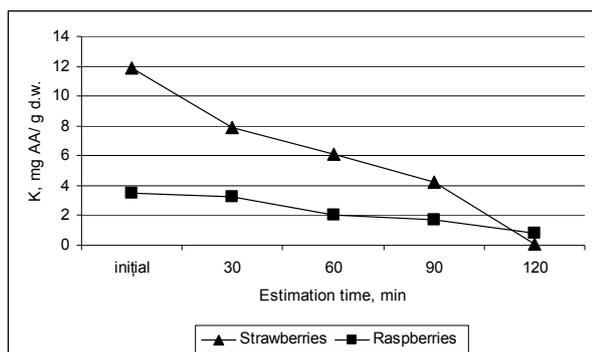
**Table 3. The intensity of strawberries breathing process**

T, °C	mg CO <sub>2</sub> kg/h, at t °C	
	Strawberry	Raspberries
0	12,5 ...15,4	20,1 ...24,2
5	17,3 ...18,2	48,5 ...55,0
10	19,5 ...23,2	87,3 ...92,5
15	48,7 ...50,2	128,3 ...137,4
20	101 ...106	195 ...200,5

Oxidation of phenol substances occurs under the action of oxygen and temperature, the speed of the process being high enough. Brown compounds are formed in result of polyphenolic oxidation. We have to mention the fact that the content of anthocyanins in strawberries is extremely variable and depend on the variety, ripeness level (10 ... 200 mg/100g product). The main anthocyanins in strawberries are cianidina-3glucozid and pelargonidina-3glucozid, which gives the fruit its red color [2, 6]

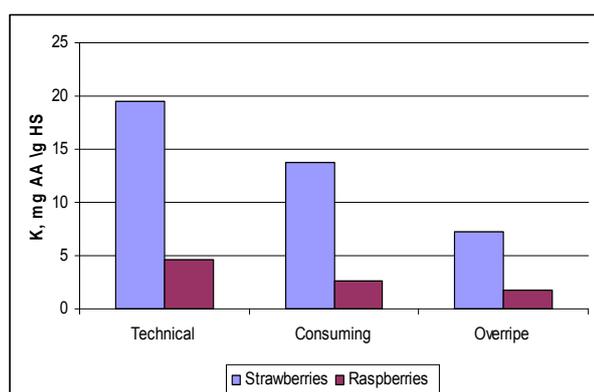
It was researched and the degradation of oxido-reducing state of fresh berries during storage. The aim was to study the interdependence between oxido-reducing state of berries and their enzymatic oxidation. Were estimated samples of fresh strawberries and raspberries. Conditions of the research: temperature 20°C, estimation time 0, 30, 60, 90 and 120 minutes. The results are shown on figure 1.

The experimental data shows that K index in strawberries decreased from 11,88 to 0,12 mg AA /g HS during 2 hours. The decrease of reducing state was around 100%. The decrease of K coefficient of raspberries in this period was 77,1% (K value was reduced from 3,5 to 0,8 AA /g SU).



**Figure 1.** The changing of oxido-reducing state of berries under the influence of enzymatic degradation.

Analyzing the experimental data we find that enzymatic oxidation of antioxidants in fresh fruits is more intense than the nonenzymatic oxidation, which was confirmed by the sudden decrease of the K coefficient. Enzymatic oxidation of antioxidants in strawberries was achieved at a higher rate than in raspberries.



**Figure 2.** Characteristics of fruit depending on level of ripeness

In figure 2 are presented data on the K index of oxido-reducing state of these berries, depending on the level of ripeness. The experimental data shows that oxido-reducing state of this berries depends mostly of their ripeness level. In technical ripening level the K coefficient has the highest rates, which means that the content of bioantioxidants is maximum and the polyphenols, anthocyanins and L-hydro-ascorbic acid were in a reduced state. In the overripe fruit the antioxidant content is shrinking what evidence and a lower reducing state, compared with the other fruit ripening level.

#### 4. CONCLUSIONS

- Strawberries and raspberries are rich in bioantioxidants: ascorbic acid, anthocyanins and total polyphenols. According to physico-chemical composition these fruits are in a reduced state and are characterised by high values of K index;
- Chemical composition of strawberries is very variable and depends on many factors: recovery mode, weather conditions, ripeness level etc. From the physico-chemical point of view, strawberries are in reduced state, redox potential of environment being estimated in the limit of 230 ... 240 mV.
- Oxido-reducing state of these berries depends on the ripeness level. In overripe fruits the K coefficient is minimal compared to fruits on technical ripeness level. To note that even overripe berries have a better reducing state than other fruits.
- The berries are highly perishable, as they have a permanent enzymatical and nonenzymatical oxidation which determine the decrease of K coefficient.

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