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STUDY OF ANTIOXIDANT CAPACITY OF THE JUICE FRUITS THROUGH MATHEMATICS METHOD

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ABSTRACT

According to the latest research, there is a combination of chemical substances in plants, known as fitonutrients, which are located in fruit pulp and skin offering antioxidant qualities and also, preventing the cancer appearance. Fruit juices have a high biological and psihosensorial value, containing fully soluble compounds from the fruits they are obtained from.

In this work, we have studied antioxidant capacity of an apple juice assortment in a global way concerning total antioxidant activity of the mixture compounds with reducing character found in product.

The results are graphically interpreted using a mathematical analysis which includes elements of regression theory and integrated calculation.

KEY WORDS:
apple juice, fitonutrients, antioxidant capacity, regression theory, integrated calculation

1. INTRODUCTION

Having in mind all the means of protection that human body possesses, it's recomandable that humans should supply these means and use antioxidants, substances that have the power of preventing or even inhibiting peroxidation. The most simple and usual mean is consuming food which contains in important quantities, active substances with reducing character *[2, 3, 4, 5]*.

According to the latest research, there is a combination of chemical substances in plants, known as phytonutrients, which are located in fruit pulp and skin offering antioxidant qualities and also, preventing the cancer appearance.

An antioxidant is one of the many chemical substances which decrease and prevent the oxidation and the destruction of cell and tissue towards free radicals from the body in which they are involved in etiology of diseases.

Thus, the combination of phytochemical substances has an important role in antioxidant and anticancerous activity and the real health benefits can come from the mixture of phytonutrients found in fruits *[3].*

Fruit juices have a high biological and psihosensorial value, containing fully soluble compounds from the fruits they are obtained from *[1, 2, 7].*

2. EXPERIMENTAL

Examining the role of bioantioxidants in sanogenesis and the prophylaxis of many diseases beside the fact that they prevalently recover in vegetal materials *[5, 6]*, in this paper was studied the natural apple juice "Apfelsaft", sugar free and without preservatives, made in Baia-Mare.

The antioxidant capacity of this assortment of fruit juice was studied, in a global way that refers to the total antioxidant activity of the mixture compounds with reducing character found in product *[9]*. We studied this assortment of fruit juice from the point of view of global action of the bioantioxidant components, like the antioxidant protective factor and not like the radicals.

The determination of the antioxidant capacity was achieved through an analysis method which consists in the oxidant action of $KMnO_4$, in an acidic medium, concerning the majority of reducing substances from vegetables *[10].* This method was adjusted for a spectrophotometric study (550 nm, 20°C) of global antioxidant capacity *[9]*, obtaining for fresh and damaged samples of apple juice (sample 1 and 2) variations of the extinction depending on the time.

Through damaged samples of apple juice we refer to next categories:

- apple juice kept at the refrigerating temperature and analyzed after three days (sample 1);
- apple juice kept at the room temperature and analyzed after three days (sample 2).

In figure 1, there was presented the extinction variation depending on the time for the fresh and damage juice of apple.

The global antioxidant capacity is decreasing proportionately with the time of the discoloring of $KMnO_4$ solution and so, it is decreasing proportionately with the time when the concentration of $KMnO_4$ solution is minimum. From the presented figures (figure 1) it was observed that while the apple juice was damaged, the global antioxidant capacity decreased; the shape of curves of the damaged samples was different from the fresh samples.

Processed experimental data from figure 1, were made using mathematical methods that include elements of regression theory and integrated calculation *[8]*.

Thus, we made an analysis which must evidence the most probable curve following the shape of the three series of experimental data:

- Seria I: Extinction = f(time) - fresh apple juice
- Seria II: Extinction =f(time) - sample 1
- Seria III: Extinction = f(time) - sample 2

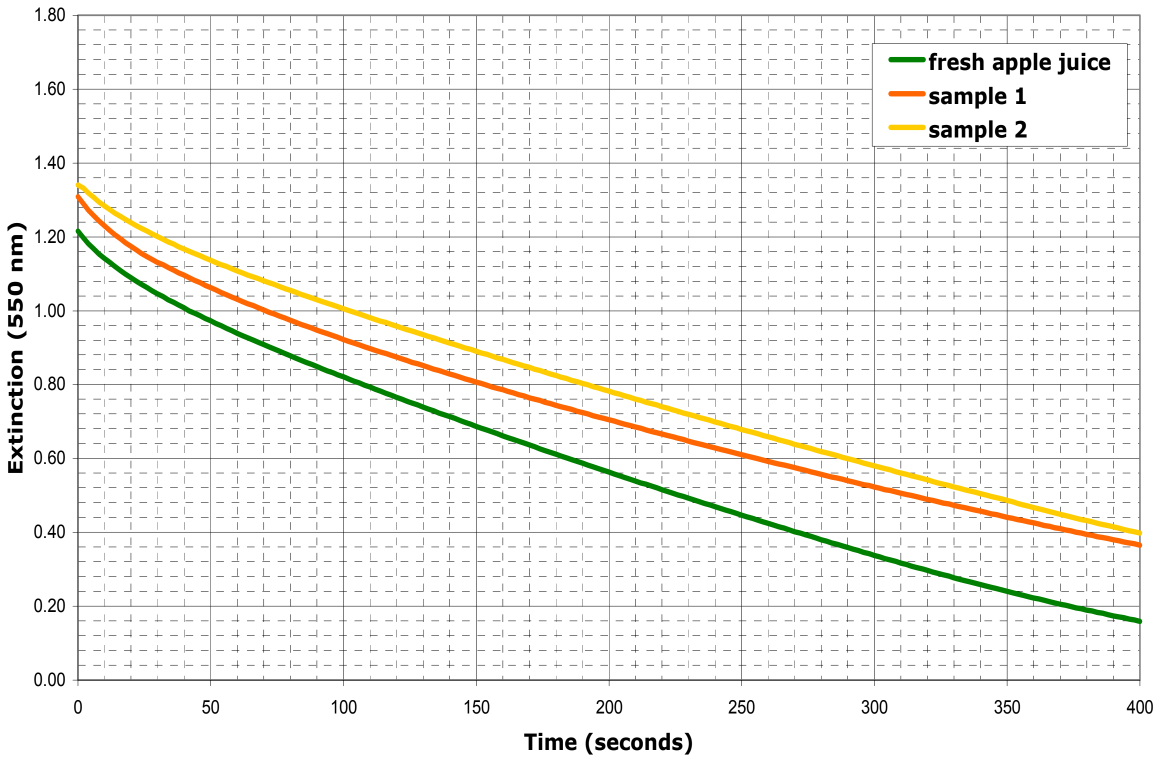

FIGURE 1. THE VARIATION OF THE EXTINCTION DEPENDING ON THE TIME – APPLE JUICE, FRESH AND DAMAGED

We propose the following types of regression functions:

LINEAR $y = a + bx$ (1)

QUADRIC $y = a + bx + cx^2$ (2)

CUBIC $y = a + bx + cx^2 + dx^3$ (3)

COMPOUND $y = ab^x$ (4)

GROWTH $y = e^{(a+bx)}$ (5)

EXPONENTIAL $y = ae^{bx}$ (6)

LOGISTIC $y = \frac{1}{\frac{1}{u} + ab^x}$, (7),

where *u* is the upper value.

Correlation coefficients for each type of proposed function, linked to the three series of experimental data, are presented in table 1.

TABLE 1. CORRELATION COEFFICIENT VALUES

FUNCTION TYPE	CORRELATION COEFFICIENT VALUES (R)		
	Seria I	**Seria II**	**Seria III**
LINEAR	0,986	0,977	0,991
QUADRIC	0,998	0,996	0,998
CUBIC	**0,999**	**0,999**	**0,999**
COMPOUND	0,977	0,997	0,994
GROWTH	0,977	0,997	0,994
EXPONENTIAL	0,977	0,997	0,994
LOGISTIC	0,977	0,997	0,994

The biggest value of correlation coefficient (R = 0,999) is obtained for function $y = a + bx + cx^2 + dx^3$ (CUBIC). Also, we obtain following coefficient values of this function, through the method of least square method:

Seria I	*Seria II*	*Seria III*
a = 1,1768	*a = 1,2657*	*a = 1,3126*
b = -0,0041	*b = -0,0042*	*b = -0,0036*
c = 6,3E-06	*c = 8,9E-06*	*c = 5,8E-06*
d = -6E-09	*d = -1E-08*	*d = -7E-09*

Graphic presentations (experimental values and calculated values) associated with these results are presented in figure 2, 3 and 4.

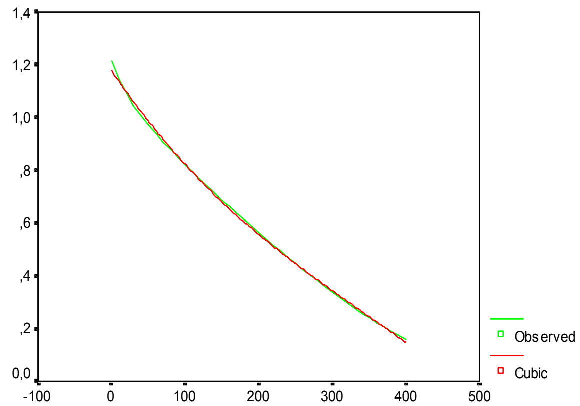

FIGURE 2 REPRESENTATION OF OBSERVED VALUES (EXPERIMENTAL) AND OF CALCULATED VALUES FOR SERIA I

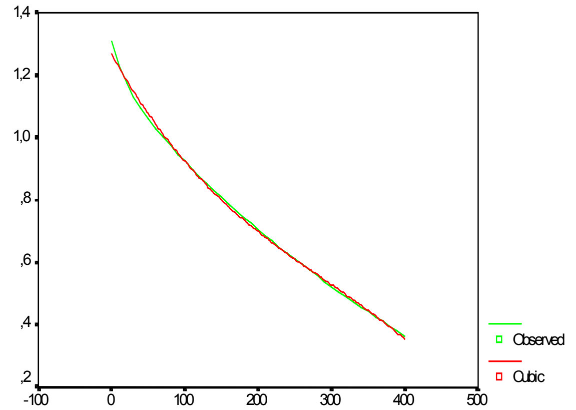

FIGURE 3 REPRESENTATION OF OBSERVED VALUES (EXPERIMENTAL) AND OF CALCULATED VALUES FOR SERIA II

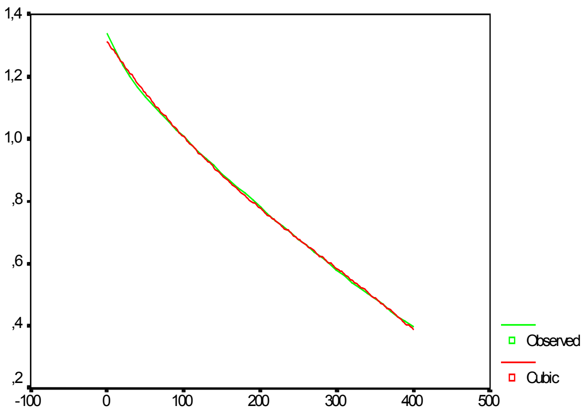

FIGURE 4 REPRESENTATION OF OBSERVED VALUES (EXPERIMENTAL) AND OF CALCULATED VALUES FOR SERIA III

The calculation of surface delimited by regression function graphic CUBIC, axe Ox and lines: x = 0, x = 400, we made through integration of definite adequate function.

$$I(a,b,c,d) = \int_0^{400} (a + bx + cx^2 + dx^3)dx = ax + b\frac{x^2}{2} + c\frac{x^3}{3} + d\frac{x^4}{4}\Bigg|_0^{400} . \qquad (8)$$

For the three series of experimental data, we obtain the following area values:

SERIA I

$A_I = I\,(1.1768,\ -0.0041,\ 6.3E\text{-}06,\ -6E\text{-}9) = \mathbf{238,72}$

SERIA II

$A_{II} = I\,(1.2657,\ -0.0042,\ 8.9E\text{-}06,\ -1E\text{-}08) = \mathbf{296,14}$

SERIA III

$A_{III}=I\,(1.3126,\ -0.0036,\ 5.8E\text{-}06,\ -7E\text{-}09) = \mathbf{298,906}$

The resulted areas from this analysis offer an image of global antioxidant capacity variation concerning analyzed sample juice (figure 5).

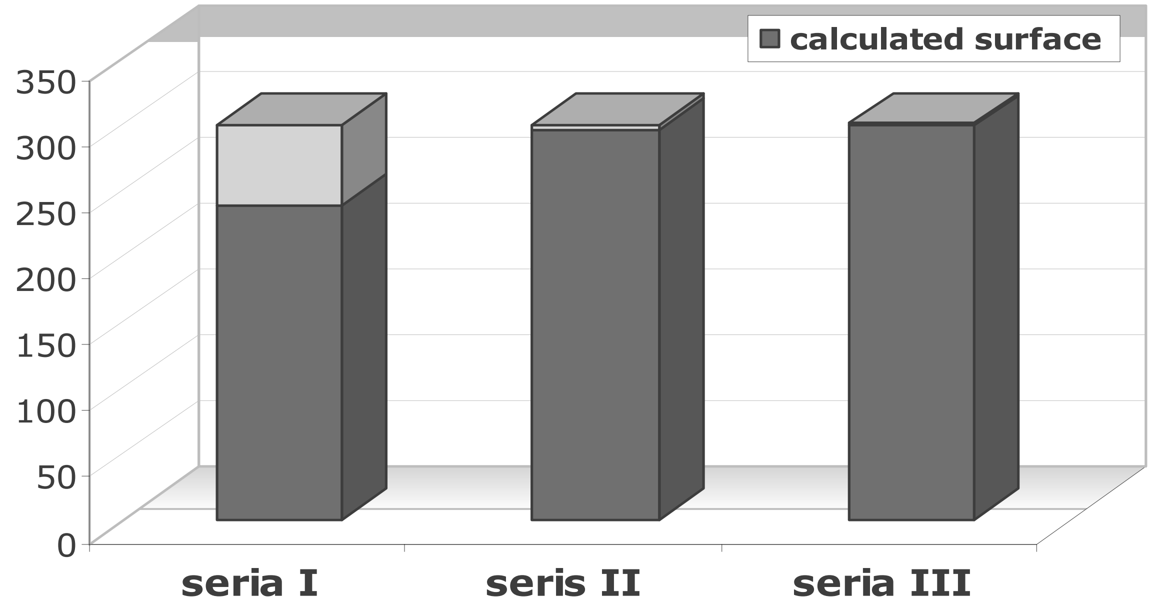

FIGURE 5. RELATIVE EXPRESSING OF THE GLOBAL ANTIOXIDANT CAPACITY

3. CONCLUSIONS

The topic of this paper was studied using a modern method for the obtaining the experimental results and for the processing of these results there were used mathematical methods, that allows the decreasing of the time period and the increasing the accuracy of the realized researches.

The global antioxidant capacity is decreasing proportionately with the time of the discoloring of $KMnO_4$ solution and so, it is decreasing proportionately with the time when the concentration of $KMnO_4$ solution is minimum. From the presented figures (figure 1) it was observed that while the apple juice was damaged, the global antioxidant capacity decreased.

The global antioxidant capacity of apple juice became an indicator of quality which reflected the accuracy ratio of product.

Using mathematical methods of interpreting experimental data, we obtain results that indicate a relation of inversed proportionality between areas delimited by calculated curves for the space of studied values, extinction = f(time), and global antioxidant capacity of apple juice (figure 5).

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