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ANTIOXIDANTS AND FOOD SAFETY

Abstract. The article discusses the importance of determining the antioxidant activity of substances in assessing the biological value of nutritional products. It is emphasized that at present, due to the variety of approaches in determining the antioxidant activity of substances and the lack of regulatory documents (national standards) to guarantee the quality and biological value of food, methodological problems arise that can be overcome by the joint efforts of researchers and legislative bodies.

Keywords: food, antioxidants, methods of measuring antioxidant activity, methodological approach, standardization of methods and products, antioxidant activity analyzer.

The urgency of the problem of food safety is increasing every year, since it is ensuring the safety of food raw materials and food products that is one of the main risk factors for public health and the preservation of the gene pool. The safety of food products should be understood as the absence of danger to human health when they are consumed [1]. In this context, it is necessary to indicate the role of antioxidants in food, the understanding of which in slowing down the peroxidation of lipids and controlling their consumption, urgently requires the determination of the total antioxidant activity (AOA) in foods of plant and animal origin [2].

Currently, there are many known methods for detecting the antioxidant activity (AOA) of substances [3], of which electrochemical methods, due to their cost-effectiveness and simplicity, are given greater preference [4]. The essence of these methods is to compare the analytical signal of an electrochemical system acting as a mediator of electron transfer, before and after adding a substance with antioxidant activity to it. Electrochemically reversible systems can be used as such a mediator electrochemical reaction: quinone-hydroquinone, ferro-ferricyanide system, iodine-iodide, NAD-NADH, and ascorbic acid, dihydroquercitin, gallic acid, etc. as the AOA standard against which measurements will be made.

And here, perhaps, the main problem of measuring AOA arises, caused by the fact that the results obtained by different researchers using their mediator systems and antioxidant standards do not correlate very often. Thus, the problem of determining AOA is not as methodical as methodological, requiring agreement and unity of analytical approaches in choosing the standard and protocol of analysis.

The purpose of this work is to provide information and the possibility of sharing finding in determining the AOA of substances using a developed electrochemical sensor [5]. The electrochemical sensor contains a measuring Au-microelectrode and Ag/AgCl located in a microcell with a volume of 0.1 ml and a digital millivoltmeter. 0.005M $K_3[Fe(CN)_6]$ was used as a mediator red-ox system and 0.0001M $K_4[Fe(CN)_6]$ in a 0.05M phosphate buffer with a pH of 6.86. The analytical signal in such a system is well reproducible. The time to establish the potential does not exceed 15 seconds. Injection of the analyzed sample, with a volume of 1.0 ml into the sensor micro-chamber, carries out its repeated washing with the analyte, which ensures reproducibility of the signal. Ascorbic acid was used as a standard, the oxidation of which to dehydroascorbic acid occurs as a result of its interaction with the oxidized form of the mediator:

$$C_6H_8O_6 + 2[Fe(CN)_6]^{3-} = C_6H_6O_6 + 2[Fe(CN)_6]^{4-} + 2\ H^+$$

The developed method and device for determining the total AOA were successfully tested on extracts of medicinal plants and herbal teas based on them [6], the study of the antioxidant activity of wine products of the oldest in Uzbekistan Samarkand wine factory named after M. Khovrenko [7]. The results of these studies are presented in tables 1 and 2.

Table 1

Antioxidant activity of water and alcohol extracts of plants of the flora of the Fergana Valley

No	Name	Latin name	AOA, mg/ml water extract	AOA, mg/ml (g) alcohol extract (40% ethanol)
1.	Yarrow	Achillea	0.097	0.216
2.	Alexandrian Leaf (Senna)	Folium Sennae	LOD*	0.171
3.	Tansy	Tanacetum	0.228	0.202
4.	Immortelle	Hypericum	0.274	0.345
5.	Wormwood bitter	Artemisia absinthium	0.122	0.214
6.	Licorice	Glycyrrhizae radices	0.087	0,173
7.	Saffron	Crocus	LOD*	0.177
8.	Calamus ordinary	Acorus calamus	0.110	0.171
9.	Rosehip	Rosa	0.210	0.387
10.	Thyme (thyme)	Thymus	0.226	0.287
11.	Horsetail field	Equisetum arvese	LOD*	0.189
12.	Fox tail	Alopecurus	0.080	0.149
13.	Cumin	Carum	0.074	0.144
14.	Elecampane (yellow)	Inula	0.237	0.255
15.	Hawthorn	Crataegus	0.082	0.306
16.	St. John 's Wort	Hypericum	0.305	0.379
17.	Chamomile pharmacy	Matricaria chamomila	0.215	0.324
18.	Melissa	Melissa officinalis	0.160	0,190

* - LOD - limit of detection

Table 2

Antioxidant activity of vintage, collectible and ordinary wines and cognacs of the JSC "Samarkand Winery named after M.Khovrenko"

No	Name	Year of manufacture	Measured potential, mV	AOA rel.ascorbic acid mg/ml	S_r
1.	Uzbekistan	1940	246.3±1.43	0.3555±0.015	0.02
2.	Aleatico	2000	246.3±2.588	0.3555±0.0275	0.03
3.	Aleatico	1951	250.7± 1,899	0.2625±0.015	0.01
4.	Red table	2007	227±2.153	1.345±0.087	0.06
5.	Aleatico	1938	241,7±3,128	0.4882±0.0457	0.03
6.	White sweet	1916	248.7± 1.899	0,3013±0.017	0.01
7.	White kishmish	1931	257.3±0.718	0.1665^0.004	0.01
8.	Aleatico	1968	249.3±2.588	0.289H0.022	0.02
9.	Malaga	1914	250.3±0.718	0.2698±0.006	0,01
10	Malaga	1916	247.7± 1.899	0.3228±0.018	0,02
11.	Saperavi dry	2014	221.0 ±1.243	2.0342±0.0757	0.06
12.	Aleatico	1991	247.7± 1.899	0.3228±0.018	0.02
13.	Magarach	1924	255,7±0,718	0.1860±0.004	0,01
14.	Shirin (vintage)	2014	241.7± 1.899	0.4882±0.028	0,02
15.	Dry red Cabernet	2015	222.7± 1.899	1.6885±0.096	0,07
16.	Aleatico	2015	237.3±1.435	0.6433±0.0276	0.03
17.	Hosilot dry wine	1932	260± 1.243	0.1383±0.0051	0,01
18.	Cahors	2015	223.7±0.717	1.6885±0.036	0.03
19.	Gulyakandoz	2013	240.7± 1.243	0.5231±0.019	0.02
20.	The wine material is dry for mounting.	2015	257.7±0.717	0.1620±0.0035	0.01
21.	Old cognac	5 years of exposure	246±0.879	0.1642±0.0047	0.01
23.	Young cognac	-	241±1.04	0.2274±0.0067	0.01
24.	Balm "Samarkand"	-	241.6±0.681	0.2188±0.0042	0.02
22.	Alcohol after the oak barrel	-	236.7±0.681	0.3012±0.0058	0.01
25.	Cognac alcohol young	-	241.3±0.717	0.2230±0.0045	0.01

Conclusion

Summarizing the above, we come to the following conclusions:

- AOA of substances included in food products is a certain indicator of the quality and safety of food products;

- currently, the results of the determination of AOA obtained by various methods are practically not comparable, as a result of which there are problems of methodological and terminological nature associated with the lack of agreement on what to take for antioxidant activity in general;

- it is time for researchers, metrologists, lawyers and other specialists to sit down at the negotiating table and come to a consensus on the development of relevant regulatory documents, for example, national standards that guarantee the quality and biological value of food.

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