

Comparison of Wines of Kakhetian and European Types according to Quantitative Content of Flavonoids and Antiradical Efficiency

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ABSTRACT. Phenolic compounds of wines prepared by Kakhetian and European technology are studied. It is shown that by the total amount of phenolic compounds, catechins, proanthocyanidins, anthocyanins and antiradical efficiency white and red wines of Kakhetian type considerably exceed white and red wines of European type.

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Key words: wine, catechins, proanthocyanidins, anthocyanins, antiradical efficiency, 2,2-diphenyl-1-picrylhydrazyl.

Adverse ecological conditions, observable in most parts of the modern world, unbalanced nutrition and various illnesses disturb the counterbalanced free-radical processes proceeding in living cells. The causes of this problem are pollution of the environment, stressful influences, radiation, chronic intoxications, smoking and other conditions, as a result of which uncontrollable free-radical reactions develop. Under the influence of these reactions the toxic effects of xenobiotics are amplified, and carcinogenesis, mutagenesis, atherosclerosis and autoimmune diseases are stimulated. In this respect, it is important to identify such foodstuffs that contain large quantities of compounds with antioxidant activity. In this aspect the Kakhetian technology of preparation of wine, used in Georgia since ancient times, is especially interesting [1]; exceptionally wines, rich in flavonoids and characterised by high antioxidant activity, are prepared by means of this technology, they considerably reduce the injury of tissues and cells [2-5].

The objective of the present study was to estimate the content of total phenolics, catechins, proanthocyanidins, and anthocyanins of the white and red wines of Kakhetian and European types, and to compare their antiradical efficiency (AE) in the system forming the 2,2-

diphenyl-1-picrylhydrazyl radical (DPPH*). White and red wines of Kakhetian and European types, prepared from the varieties of grapes (*Vitis vinifera* L.) cultivated in Georgia, were supplied to us by wineries and physical persons, for which we express our sincere gratitude to them. Technology of preparation of white (W) and red (R) wines, the grapes variety, cultivation micro-district, winery and the method of preparation of wine are specified in Table 1.

The content of total phenolic compounds in wines was analyzed with Folin-Ciocalteu reagent [6], the content of catechins and proanthocyanidins was determined by the method of Swain and Hillis [7], and the content of anthocyanins – according to Durmishidze and Sopromadze [8]. Calibration curves were plotted: for total phenols – with gallic acid (“Sigma”, maximum absorption 765 nm), for catechins with (+)-catechin (“Theodor Schuchardt”, maximum absorption 500 nm), for proanthocyanidins – with enine-chloride isolated from grape skin extract (maximum absorption 550 nm) [9], and for anthocyanins – with malvidin-3-glucoside (maximum absorption 536 nm) [8].

In order to determine the antiradical efficiency of the analyzed samples of wines use was made of 2,2-diphenyl-1-picrylhydrazyl (DPPH*), with maximum absorption

Table 1

Wine Samples*

Wine	Technology of preparation	Grape variety	Cultivation microdistrict	Winery	Year of preparation
1W	Kakhetian	Khikhvi	Tsinandali	Physical person	2005
2W	Kakhetian	Rkatsiteli	Kardenakhi	“Okros Khvanchkara” Ltd.	2005
3W	European	Mtsvane	Gurjaani	Physical person	2004
4W	European	Rkatsiteli	Gurjaani	Physical person	2004
5W	European	Tsulukidzis tetra	Ambrolauri	“Okros Khvanchkara” Ltd	2004
6R	European	Aleksandreuli	Ambrolauri	“Okros Khvanchkara” Ltd.	2003
7R	Kakhetian	Cabernet Sauvignon	Eniseli	Vazi + Ltd	2005
8R	Kakhetian	Ojaleshi	Salkhino	Vazi + Ltd	2005
9R	Kakhetian	Saperavi	Napareuli	Vazi + Ltd	2005

* W – White wine; R – Red wine

520 nm [10,11]. The wine samples (50 ml) were distilled in a rotary evaporator at temperature of 50°C to remove alcohol and were then restored to initial volume with distilled water. Spectrophotometric determinations were carried out on the spectrophotometer CФ-26 (Russia). Each experimental variant was repeated five times. Experimental data were processed statistically by computer program “MS Excel”.

According to our findings (Table 2), comparison of white and red wines prepared with Kakhetian [10] and European [12] technology shows clearly that in terms of the content of phenolic compounds wines of Kakhetian type (1W, 2W, 7R, 8R, 9R) considerably exceed those of European type (3W, 4W, 5W, 7R). In white wines prepared with Kakhetian technology the total content of phenolic compounds varies in the range of 2000 mg (wine 1W) to 2290 mg (wine 2W) per litre, and in red wines prepared with Kakhetian technology the total content of phenolic compounds varies in the range, of 2848 mg (wine 7R) to 4416 mg (wine 9R) per litre, while in white wines prepared with European technology this parameter varies in the range of 278 mg (wine 3W) to 456 mg (wine 5W) per litre, and in red wines it reaches 1630 mg/litre (wine 6R). Thus, preparation of wine with Kakhetian technology

highly enriches the wine with phenolic compounds. According to our data, the average value of the sum of phenolic compounds of Kakhetian white and red wines 5.86 and 2.24 times exceeds the average value of the sum of phenolic compounds of European white and red wines, respectively (Table 2). This is due to the preparation of wines with Kakhetian technology, according to which the grape juice, together with the skin and pulp, is placed in a *kvevri* (wine jar) buried in the ground, and fermented. In this way, during alcoholic fermentation a large quantity of flavonoids is extracted by the grape juice from grape stems, skins and seeds, determining the essence of Kakhetian wine; as a result of the interaction of these substances with oxidizing enzymes of grape stems and skins, the specific color, taste and aroma characteristic of Kakhetian wine is created [1].

It is necessary to note also that by the content of catechins the white (1W, 2W) and red (7R, 8R, 9R) wines of Kakhetian type considerably exceed the white (3W, 4W) and red (6R) wines of European type (Table 2). In particular, the average value of the sum of catechins of Kakhetian white and red wines 11.6 and 2.3 times exceeds the average value of the sum of catechins of European white and red wines, respectively. Among wines of

Table 2

The Content of Total Phenolics, Catechins, Proanthocyanidins, Anthocyanins in White and Red Wines and Antiradical Efficiency

Wine	Total phenolics, mg/l	Catechines, mg/l	Proanthocyanidins, mg/l	Anthocyanins, mg/l	EC ₅₀ (g antioxidant Kg ⁻¹ DPPH*)	T _{EC} 50 (min)	AE
1 W	2000±13	453±01	1097±2.4		515±16	4.5	0.43
2 W	2290±38	640±007	690±7.1		510±11.7	4.5	0.44
3 W	278±7	27±2	43.2±1.1		1447±22.4	5	0.12
4 W	346±11	39±1	47.8±2		1191±14.1	5	0.16
5 W	456±26	77±2	165±8.7		1219±18.4	4.5	0.18
6 R	1630±50	378±15	980±69	53.2±5	595±14.5	5	0.34
7 R	2848±72	798±2	728±13	317±24	382±14.9	5	0.52
8 R	3700±85	862±11	872±18	414±20	342±11.5	5	0.58
9 R	4416±100	1010±23	1203±18	1270±45	510±16.5	3.2	0.62
α-Tocopherol					625±22.7	5	0.32

Kakhetian type white (2W) and red (9R) wines are distinguished, in which the content of catechins is 640 mg/L and 1010 mg/L, respectively.

A similar pattern is observed also by comparison of contents of proanthocyanidins of white and red wines prepared with Kakhetian and European technology (Table 2). It is obvious that preparation of wine in kvevri with Kakhetian technology and increase of the maceration period have a positive influence on the concentration of proanthocyanidins in wine. Among wines of Kakhetian type white (1W) and red (9R) wines are distinguished, in which the content of proanthocyanidins is 1097 mg/l and 1203 mg/l, respectively (Table 2). At the same time, the average value of the sum of proanthocyanidins of Kakhetian white wines about 4 times exceeds the average value of the sum of proanthocyanidins of European white wines.

Preparation of wine with Kakhetian technology has a positive influence on the concentration of anthocyanins in wine. Such examples are red wines (7R, 8R and 9R) in which the content of anthocyanins is in the range of 317-1270 mg/l, whereas in red wine prepared with European technology (6R) the content of anthocyanins is 53.2 mg/l (Table 2).

Thus, study of the total amount of phenolic compounds, catechines, proanthocyanidins, and anthocyanins of white and red wines prepared with Kakhetian and European technology has demonstrated that by content of the said compounds Kakhetian wines considerably exceed European wines, which is evidenced by the high medical and prophylactic properties of wines of Kakhetian type. This has been confirmed by the investigation of the antiradical efficiency (AE) of wines of Kakhetian and European type (Table 2). According to these findings the average value of AE of white and red wines of Kakhetian type 2.8 and 5 times exceeds the average value of AE of white and red wines of European type, respectively. Among wines white (1W, 2W) and red (7R, 8R, 9R) wines of Kakhetian type are especially distinguished for their antiradical efficiency.

The data of some authors on the enrichment of European type white wines by polyphenols should be noted. According to Auger *et al.*, white wine prepared from grape variety "Chardonnay", enriched with polyphenols possesses a protective effect against early forms of atherosclerosis in hamsters [13], and according to B. Fuhrman *et al.*, white wine enriched with polyphenols possesses antiradical properties similar to red wine [14].

ბიოქიმია

კახური და ევროპული ტიპის ღვინოების შედარება ფლავონოიდების რაოდენობრივი შემცველობის და ანტირადიკალური ეფექტურობის მიხედვით

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ნაშრომში შესწავლილია კახური და ევროპული ტექნოლოგიით დაყენებული ღვინოების ფენოლური ნაერთები. ფენოლების ჯამის, კატეხინების, პროანტოციანიდინებისა და ანტოციანების რაოდენობრივი შემცველობისა და ანტირადიკალური ეფექტურობის მიხედვით კახური ტიპის თეთრი და წითელი ღვინოები მნიშვნელოვნად აღემატებიან ევროპული ტიპის თეთრ და წითელ ღვინოებს.

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Received October, 2007