საქართველოს მეცნიერებათა ეროვნული აკადემიის მოამბე, ტ. 8, №1, 2014
BULLETIN OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES, vol. 8, no. 1, 2014

Biochemistry

Chemical Composition and Functional Role of Oil Extracted from Seeds of Saperavi Grape Variety (*Vitis vinifera* L.)

Tea Mchedluri*, Darejan Margalitashvili*, Nugzar Aleksidze**

* *I. Gogebashvili State University, Telavi*
** *Academy Member, St. Andrew the First Called Georgian University of the Patriarchate of Georgia, Tbilisi*

ABSTRACT. Chemical composition of oil, extracted from the seeds of Saperavi grape variety, in particular, quantitative content of fatty acids, biogenic amines and amino acids and their influence on physiological activity of white Wistar rats were investigated. Constituents of grape seed oil were separated using the method of high-pressure liquid chromatography (WATTERS, USA) on Nova-Pak column C18 (100 mm, 83.2mm) and determined on a fluorescent detector (at 270 nm). Effects of extracted solutions on emotional state of adult Wistar rats were tested in special experiments and evaluated using Irvin's scale. Saturated and unsaturated fatty acids (lauric, myristic, palmitic, stearic, oleic, linolenic and arachidonic acids), biogenic amines (serotonin, dopamine, noradrenaline, adrenaline) and amino acids (aspartic and glutamic acids, asparagine, phenylalanine, tyrosine, threonine, tryptophane, leucine, methionine, proline, alanine, glycine) were found to improve functional state of white rats and, as a result, to alleviate aggressive behaviour. Application of grape seed oil in medical practice for curative purposes seems to be very prospective. *© 2014 Bull. Georg. Natl. Acad. Sci.*

Key words: *grape seed oil, Saperavi, chromatography.*

It is known that moderate consumption of Saperavi wine positively influences human health and noticeably improves performance of the central nervous system (CNS) [1], normalizes cardiac rhythm and increases organism's resistance to diseases [2]. It is established that transfer of biologically active substances from grape berries to wine takes place in the process of wine-making. Considering the above facts our aim was to study chemical composition of grape seed oil and ascertain its biological role.

Materials and methods

The object of present investigation was oil extracted from the seeds of Saperavi grape variety by the method of cold pressing [3]. Grape seed oil has light yellow coloration and pleasant aroma. Probes for the analysis were prepared according to the state standard (51486-99).

Organic components of grape seed oil were studied after removal of tannic and volatile substances. For this purpose the solution under investigation

Table 1. Quantitative distribution of fatty acids in the oil extracted from seeds of grapevine variety Saperavi (mg/100g)

#	Fatty acids	Content (mg/100g)
1.	Lauric acid	5.4±0.02
2.	Myristic acid	6.3±0.05
3.	Palmitic acid	8.1±0.03
4.	Stearic acid	4.5±0.04
5.	Oleic acid	21.1±0.04
6.	Linolenic acid	51.4±0.15
7.	Arachidonic acid	3.1±0.02

was transferred to the separating funnel of 100 ml capacity and extraction was performed 2 times using 10 ml of hexane. The obtained uniform extract was washed-off with distilled water and dried using anhydrous sodium sulphate. Constituents of grape seed oil were separated using the high-pressure liquid chromatography (HPLC, WATTERS, USA,) on Nova-Pak column C18 (100 mm, 83.2 mm) and their quantities determined on the fluorescent detector (at 270 nm). Chromatography rate was 2.0 ml/min.

Effects of extracted solutions on the emotional state of adult Wistar rats were studied in special experiments. Total 30 animals weighing 200±2.0 g were tested. Experimental animals were placed into four standard cages in conditions of full value nutrition regime. Once a day the experimental animals were administered 0.2 ml, 0.6 ml or 1 ml of 25% solution of grapevine seed extract per os using a special disposable catheter, while control animals were given 5 ml of distilled water. After termination of experiments the effects of substances, extracted from grape seeds were studied and emotional state of animals was evaluated according to Irvin's scale [4]. Then the animals were euthanized and their internal organs subjected to pathomorphological examination.

Results and Discussion

In the first series of experiments we investigated distribution of fatty acids in the oil extracted from seeds of Saperavi grapes. Oil extracted from the grape seeds was found to be comparatively rich in unsaturated fatty acids, in particular, oleic and linolenic acids. These acids are not synthesized in animal organism and are regarded to be as significant as vitamins. Grape seed oil contains also lauric acid (5.4 mg/100g), myristic acid (6.3 mg/100g), stearic acid (4.5 mg/100g) and arachidonic acid (3.1 mg/100g). Their quantitative content calculated in milligramms per 100 g of dry weight is presented in Table 1.

It is known that linolenic acid is applied for prevention of immune deficiency, for treatment of diabetes mellitus, atherosclerosis and for rehabilitation after a heart attack [5]. It is often used for treatment of infectious diseases and restoration of damaged function of the Central Nervous System [6]. It is especially noteworthy that linolenic acid favours reduction of cholesterol content in blood [7], thus preventing the development of atherosclerosis in animals. The rest fatty acids – myristic, palmitic, stearic and arachidonic acids are actively involved in provision of an organism with energy [8].

It should be noted that administration of grape seed oil per os did not cause changes in Wistar rats either at anatomic level or at the level of internal organs. No deviations were marked in the weight gain of animals.

Reuslts of study of biogenic amines and amino acids contained in grape seed turned out to be very interesting. Chromatography allowed to detect such biologically active substances, which play special role in integral functioning of the Central Nervous System (Table 2).

Oil extracted from the seeds of Saperavi grapes was found to contain especially high amount of serotonin (38 mg/100 g), which has a significant role in brain functioning. In particular, presence of excess of serotonin in the brain alleviates stress, reduces incidence of aggression, murder and suicide [9]. This can serve as a presumable explanation of the fact that administration of grape seed oil *per os* caused reduction of aggressive behaviour in experimental animals. Oil extracted from the seeds of Saperavi grapes contains comparatively less, but still quite

Table 2. Quantitative distribution of biogenic amines in oil extracted from seeds of grapevine variety Saperavi

#	Biogenic amines	Content (in %)
1.	Serotonin	38±0.20
2.	Dopamine	27±0.15
3.	Noradrenaline	18.3±0.12
4.	Adrenaline	16.7±0.09

significant amount of dopamine – (6.5 *mg*/100 *g*), which has positive effect on the course of Parkinson's disease [10]. Dopamine is a neurotransmitter and it is actively involved in the functional activity of brain.

Adrenaline and noradrenaline as neurotransmitters actively participate in metabolic processes proceeding in the nervous system. Adrenaline supplies animal organisms with energy via mobilisation of glucose [11, 12].

Significant results were obtained in terms of quantitative distribution of amino acids in the Saperavi grape seed oil. 12 amino acids have been detected in the grape seed oil (Table 3).

As Table 3 shows, grape seed oil is characterized by comparatively high content of tryptophane and aspartic acid, 18.67 mg/100 g and 11.6 mg/100 g, correspondingly. These amino acids are known to significantly improve functioning of the Central Nervous System. Aspartic and glutamic acids are neurotransmitters involved in energetic shifts and mechanisms preventing the organism from the toxic ammonium. Phenylalanine is known to improve memory and the ability for learning. Threonine stimulates activity of the Central Nervous System. Deficiency of tryptophane causes weakening of mental abilities. Tryptophane eliminates depression and improves sleep. Leucine is a source of psychic energy. Methionine reduces excitation and anger. Proline is a synergist of an inhibiting effect of gamma-aminobutyric acid. Alanine is a source of energy for the brain.

Table 3. Quantitative distribution of amino acids in oil extracted from seeds of grapevine variety Saperavi (mg/100g)

#	Amino acid	Content (mg/100g)
1.	Aspartic acid	11.65±0.4
2.	Glutamic acid	8.05±0.2
3.	Asparagine	5.84±0.5
4.	Phenylalanine	8.76±0.5
5.	Tyrosine	6.0±0.3
6.	Threonine	9.77±0.9
7.	Tryptophane	18.67±0.7
8.	Leucine	5.34±0.7
9.	Methionine	6.15±0.8
10.	Proline	4.80±0.4
11	Alanine	7.48±1.0
12.	Glycine	7.49±0.9

Results of our experiments show that oil extracted from grape seeds, which is rich in biogenic amines and several essential amino acids, significantly improves functional activity of living organisms.

Production of oil from seeds of Saperavi grapes and its use in medicine seems to be very prospective.

ბიოქიმია

საფერავის ჯიშის ყურძნის წიპწის ზეთის ქიმიური შედგენილობა და მისი ფუნქციური როლი

თ. მჭედლური*, დ. მარგალიტაშვილი*, ნ. ალექსიძე**

** ი. გოგებაშვილის სახ. სახელმწიფო უნივერსიტეტი, თელავი*
*** აკადემიის წევრი, საქართველოს საპატრიარქოს წმიდა ანდრია პირველწოდებულის სახ. ქართული უნივერსიტეტი, თბილისი*

შესწავლილია საფერავის ჯიშის ყურძნის წიპწის ზეთის ქიმიური შედგენილობა, კერძოდ, ცხიმოვანი მჟავების, ბიოგენური ამინების და ამინომჟავების რაოდენობრივი შემცველობა და მათი გავლენა ვისტარის ხაზის თეთრი ვირთაგვების ფიზიოლოგიურ აქტივობაზე. წიპწის ზეთში შემავალი ნივთიერებების დაყოფას ვახდენდით მაღალწნევიანი თხევადი ქრომატოგრაფიით (WATTERS, USA) Nova-Pak C18 -ის სვეტზე (100 მმ, 83, 2 მმ) ფლუორესცენტულ დეტექტორზე (270 ნმ). სპეციალურად შევისწავლეთ ექსტრაგირებული სხნარების ეფექტები ვისტარის ხაზის ზრდასრული ვირთაგვების ემოციურ მდგომარეობაზე ირვინის შკალის მიხედვით. დადგენილი იქნა, რომ საფერავის ჯიშის ყურძნის წიპწიდან გამოყოფილი უჯერი და ნაჯერი ცხიმოვანი მჟავები (ლაურინის, მირისტინის, პალმიტინის, სტეარინის, ოლეინის, ლინოლენის და არაქიდონის მჟავები), ბიოგენური ამინები (სეროტონინი, დოფამინი, ნორადრენალინი და ადრენალინი) და ამინომჟავები (ასპარაგინის მჟავა, გლუტამინის მჟავა, ასპარაგინი, ფენილალანინი, თიროზინი, ტრეონინი, ტრიპტოფანი, ლეიცინი, მეთიონინი, პროლინი, ალანინი და გლიცინი) აუმჯობესებენ თეთრი ვირთაგვების ფუნქციურ მდგომარეობას და შედეგად, მნიშვნელოვნად მცირდება აგრესიული ქცევები. ისახება საფერავის ყურძნის წიპწის ზეთის სამკურნალოდ გამოყენების დიდი პერსპექტივა.

REFERENCES:

1. *A.P. Whelan, W.H.F. Sutherland, M.P. Mccormick*, et al. (2004), Internal Medicine Journal, 34: 224-228.
2. *D.P. Agarwal* (2002), Alcohol, **37**, 5: 409-415.
3. *V.A. Boshkan, R.E. Darmograi, V.I. Deera*, et al. (2005), J. Provizor, 5: 55-59 (in Russian).
4. Rules of Laboratory Practice (GLP), 2003 (in Russian).
5. *T. Devlin* (2005), Biochemistry with clinical correlations. Tbilisi State Medical University (in Georgian).
6. *A. Davalos, A. Shuaib, N.G. Walhgren* (2000), J. Stroke Cerebrovasc. Dis., 9: 2-8.
7. *R. S. Maksyutin, A.P. Komissarenko, I. Prokopenko*, et al. (1985), Rastitel'nye lekarstvennye sredstva. M. (in Russian).
8. *V. Petkov*, ed. (1988), Sovremennaya fitoterapiia. Sofia (in Russian).
9. *N. Aleksidze* (2010), Normal and pathological biochemistry for physicians. Tbilisi (in Georgian).
10. *M. Nikolaishvili, T. Mchedluri, D. Margalitashvili*, et al. (2010), Experimental and clinical medicine, 6: 28-31(in Georgian).
11. *J. Killestein, N.F. Kalkers, C.H. Polman* (2005), Neurol. Sci ., **233**, 2: 113-115.
12. *A.A. Benduryshev, E.B. Peshkova, A.V. Pirogov*, et al. (2010), Vesti Moskovskogo Universiteta, SSR 2. Chemistry: 51:54 (in Russian).

Received January, 2014