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COMPARATIVE ANALYSIS OF MECHANICAL COMPOSITION AND DYNAMICS OF PHYSICOCHEMICAL PARAMETERS IN "ARENI SEV" GRAPE VARIETY AND ITS CLONES

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Within the scope of this study, a comparative analysis was conducted on the mechanical composition and dynamics of physicochemical parameters of the Vitis vinifera cultivar "Areni Sev" and its clones: "Nosr Areni", "Areni Sev Clone №9", "Areni Sev Clone №15", and "Areni Sev Clone Berqatu". The investigations were carried out in 2024–2025 at the National Grape Collection Vineyard located in the Ejmiatsin region of Armavir Province, Armenia.

The dynamics of sugar accumulation, titratable acidity, and pH were examined, along with structural and compositional indicators of the bunch and berries, in accordance with the methodology developed by N.N. Prostoserdov.

The obtained results demonstrate that clonal selection significantly improves the agrobiological and technological characteristics of the "Sev Areni" variety. In particular, "Nosr Areni" and "Areni Sev Clone №9" stand out with superior bunch structural indices, higher pulp-to-juice ratios, and more intensive dynamics of sugar accumulation. The cluster composition index was 3.21 for the "Areni Sev" variety, with the highest values recorded for "Areni Sev Clone №9" and "Nosr Areni".

Differences in mechanical composition in terms of berry number, seed mass, and skeletal proportion indicate the influence of genetic mutations on productivity and juice yield. The obtained data confirm that the studied clones are promising for the production of high-quality wines and can be purposefully applied to enhance winemaking efficiency under Armenian climatic conditions.

Keywords: "Areni Sev", "Areni Sev clone №15", mechanical composition,, grape variety and clones, clonal selection, Dynamics of physicochemical parameters.

Introduction. The history of viticulture shows that, right from ancient times, the unique features of grapevines as long-term cultivated plants and the natural variations they display have always drawn the interest of researchers and farmers through different eras. For instance, Columella suggested picking the best-

performing vines for vegetative propagation, focusing on those with strong yield records [1].

Research into vegetative variation in perennial crops like grapevines has revealed that offspring from this kind of reproduction are best seen as groups of clones. These groups share key biological and economic qualities, but they can still differ quite a bit in things like color, shape, size, growth stages, phenophase lengths, and so on [2,3].

One key step in carrying out clonal selection is first spotting the top performing areas in the vineyards under study. That's where you observe and test the vines, while also clearing out any unwanted ones to clean up the plot [2].

Essentially, clones are plants from the same variety produced through vegetative means, yet they can vary significantly from one another in bunch size and density, overall yield, sugar buildup, and other traits. This makes it important to selectively identify and spread varieties that have picked up useful mutations [4].

Implementation of clonal selection has been shown to enhance vineyard productivity by a factor of two to five across diverse viticultural regions, including Germany, Italy, France, and California, thereby improving both yield efficiency and the technological quality of grape production [1].

Determining the suitability and intended use of a cultivar relies heavily on oenological research. Oenology primarily involves studying the structural components of the rachis and fruit according to their mechanical composition. During clonal selection, attention is focused on improving cultivar traits such as rachis and berry dimensions, the weight of 100 berries, and the number of berries per cluster.

It should be noted that in winemaking, the ratio of the rachis, berries, berry skin, pulp, seeds, juice, and pedicel is determined through mechanical analysis. Notably, this ratio can vary depending on the grape cultivar, soil and climatic conditions of cultivation, berry ripeness, and applied agrotechnical practices [5-7].

Analysis of the mechanical composition of grapes allows the determination of the characteristic structure of the cluster for a given cultivar, as well as the proportional relationships among its various components, which is crucial from a technological standpoint [8].

Materials and methods. A comparative study was conducted on the mechanical composition and physicochemical parameters of the “Areni Sev” grape cultivar and its clones: “Nosr Areni”, “Areni Sev clone №9”, “Areni Sev clone №15” and“Areni Sev clone Berqatu” . For each clone and the cultivar, five clusters were analyzed in three replicates. The study was carried out in 2024–2025 at the

National Grape Collection Vineyard located in the Ejmiatsin region of Armavir Province, Armenia.

"Areni Sev" is classified among late-ripening wine grape [9]. The mechanical composition of the cultivars was assessed according to the methodology developed by N.N. Prostoserdov [10]. Specifically, the weight of the cluster, berry skin, and pedicel, as well as the number of berries per cluster and the weight of seeds, were determined. The berry skin was weighed immediately after separation from the berries. Based on the obtained data, the structure and composition of the clusters of the studied cultivar and clones were compared.

The sugar content of the grape juice was determined using a refractometric method with a laboratory refractometer, and the results were expressed in °Brix.

Titratable acidity was measured by titration with a 0.1 N sodium hydroxide (NaOH) solution using phenolphthalein as an indicator, and the results were expressed as grams per liter of tartaric acid equivalent (*g/L*).

The pH of the grape juice was measured using an electronic pH meter in accordance with ISO 10523 standard [11].

Results and discussion. The improvement of the agrobiological characteristics of locally cultivated grape varieties through clonal selection plays a crucial role in the production of high-quality wines. Key primary indicators characterizing the grapes include sugar content, titratable acidity, and pH. The evolving physicochemical profiles of the examined Areni cultivar and its clones are outlined in Tables 1.

The data illustrate the ripening dynamics of grapes in September 2025 marked by an increase in sugar content, a decline in titratable acidity TA, and fluctuations in Ph, patterns typical of viticultural processes.

"Areni Sev" and its clones (№9, №15, berqatu) generally maintain sugar levels within the 19…22% range, though the berqatu clone stands out with higher sugar accumulation up to 22%, suggesting potential for faster maturation.

"Nosr Areni" shows the most substantial sugar rise from 19% to 22%, but the sharp drop in TA from 4.41 to 2.6 may indicate risks of acidity imbalance, which could affect wine stability.

Overall trends: The reduction in TA averaging from 4.5 to 2.8 aligns with organoleptic ripening, yet the pH increase in certain clonese.g., up to 3.99 in №9 might necessitate pH adjustments during winemaking to ensure microbiological stability.

Table 1

Dynamics of physicochemical parameters of the "Areni Sev" variety and its clones

	11.09.2025			19.09.2025			29.09.2025		
	sugar	PH	TA	sugar	PH	TA	sugar	PH	TA
Areni Sev	20,0	3,75	4,51	20,2	3,51	4,16	20,4	3,5	2,75
Nosr Areni	19.0	3,74	4,41	20,8	3,77	4,33	22,0	3,79	2,6
Areni Sev Clone №9	20.1	3,83	4,56	20,2	3,87	4,13	20,6	3,99	3,80
Areni Sev Clone №15	19,2	3,59	5,41	19,5	3,63	4,91	19,8	3,90	2,83
Areni Sev clone berqatu	21,0	3,55	5,31	22,0	3,64	5,05	22,0	3,85	2,67

The studies of the mechanical composition of the "Areni Sev" grape variety and its clones ("Nosr Areni", "Areni Sev clone No. 9", "Areni Sev clone No. 15", and "Areni Sev clone berqatu") are presented in Table 2.

Table 2

Mechanical composition of the "Areni Sev" and its clones

Grape Variety and Clones	**Bunch length, *cm***	**Bunch Width, *cm***	**Bunch Mass *G***	**Number of berries in the bunch, *n***	**Berries Mass, *g***	**Stem mass, *g***	**Skin mass, *g***	**Seed mass, *g***	**Hard residue mass, *g***	**Berries pulp+juice, *g***
Areni Sev	15,1	11,9	259,8	130	247,2	12,6	39,1	9,9	52,6	207,3
Nosr Areni	18,9	10,8	272.9	158	263,3	9,6	32,1	10,3	40,2	232,7
Areni Sev Clone №9	17,1	11,1	375,4	171	359,8	15,6	41,2	12,7	57,4	318,0
Areni Sev Clone №15	16,3	12,2	331,8	137	319,7	12,1	56,4	11,4	72,2	259,6
Areni Sev clone berqatu	15,8	10,5	295,8	131	284,4	11,5	42,8	11,2	55,4	240,4

The bunch length, of the Areni Sev variety and its clones ("Nosr Areni", "Areni Sev clone No. 9", "Areni Sev clone No. 15", and "Areni Sev clone berqatu") was 15.1 *cm*, 18.9 *cm*, 16.3 *cm*, 15.8 *cm*, and 10.5 *cm*, respectively, while the bunch width, was 11.9 *cm*, 10.8 *cm*, 11.1 *cm*, 12.2 *cm*, and 10.5 *cm*, respectively.

The bunch mass amounted to 259.8 *g*, 272.9 *g*, 375.4 *g*, 331.8 *g*, and 295.8 *g*, respectively, whereas the berries mass, was 247.2 *g*, 263.3 *g*, 359.8 *g*, 319.7 *g*, and 284.4 *g*.

The highest stem mass, g was recorded in "Areni Sev clone No. 9" (15.6 *g*), followed by "Areni Sev" (12.6 *g*), "Areni Sev clone No. 15" (12.1 *g*), "Areni Sev clone berqatu" (11.5 *g)*, and "Nosr Areni" (9.6 *g).*

The highest seed mass, was also observed in "Areni Sev clone No. 9" (12.7 g), followed by "Areni Sev clone No. 15" 11.4 *g*, "Areni Sev clone berqatu" (11.2 *g*), " Nosr Areni" (10.3 *g*), and "Areni Sev" (9.9 *g*).

The structure of a grape cluster is characterized by its average weight, the number of berries, the weight of the berries and peduncle, their percentage composition within the cluster, as well as by the cluster structural index. A higher structural index indicates more efficient utilization of the cluster and results in increased juice yield.

The cluster structural index is determined as the ratio of the combined berry weight to the peduncle weight (Table 3).

Table 3

Bunch structure of the "Areni Sev" Grape variety and its clones

Grape variety and clones	Average bunch mass, g	Number of berries in the bunch, n	Berries mass, g	Berries ratio to the bunch, %	Stem mass, g	Stem ratio to the bunch, %	Bunch structure index	Berries index
Areni Sev	259,8	130	247,2	95,2	12,6	4,80	19,7	50,0
Nosr Areni	272.9	158	263,3	96,5	9,6	3,50	27,5	57,9
Areni Sev clone №9	375,4	171	359,8	95,8	15,6	4,20	23,1	45,6
Areni Sev clone №15	331,8	137	319,7	96,4	12,1	3,60	26,4	41,3
Areni Sev clone berqatu	295,8	131	284,4	96,1	11,5	3,90	24,8	44,3

The grape variety “Areni Sev” and its clones “Nosr Areni”, “Areni Sev Clone №9”, “Areni Sev Clone №15”, and “Areni Sev Clone berqatu ” differ significantly in terms of cluster and berry weight. Compared to the “Areni Sev” variety, “Areni Sev Clone №9” produces a higher number of berries. Specifically, the “Areni Sev” variety had 130 berries per cluster, “Nosr Areni” had 158 berries, “Areni Sev Clone №15” had 137 berries, “Areni Sev Clone berqatu” had 131 berries, and the highest berry count was recorded in “Areni Sev Clone №9”, with 171 berries per cluster. The maximum peduncle weight was observed in “Areni Sev Clone №9” (15.6 *g*), followed by the “Areni Sev” variety (12.6 *g*), “Areni Sev Clone №15” (12.1 *g*), “Areni Sev Clone berqatu” (11.5 *g*), and “Nosr Areni” (9.6 *g*). No significant differences were observed in the ratio of berry to peduncle weight among the “Areni Sev” variety and its clones. The cluster structural index calculated as the ratio of berry weight to peduncle weight, was 19.7 for the “Areni Sev” variety, 27.5 for “Nosr Areni”, 23.1 for “Areni Sev Clone №9”, 26.4 for “Areni Sev Clone №15”, and 24.8 for “Areni Sev Clone berqatu”. According to the study, the berry index of the “Areni Sev” grape and its clones, defined as the number of berries per 100 g of cluster, was as follows: 50.0 for “Areni Sev”, 57.9 for “Nosr Areni”, 45.6 for “Areni Sev Clone №9”, 41.3 for “Areni Sev Clone №15”, and 44.3 for “Areni Sev Clone berqatu”. The results of the berry composition analysis - including the weight of 100 berries and 100 seeds, the number and weight of seeds per 100 berries, and the weights of berry skin and pulp plus juice are presented in Table 3. Of particular importance is the berry composition index calculated as the ratio of pulp plus juice weight to berry skin weight. In the “Areni Sev” grape variety, the number of seeds per 100 berries was 215, while in the clones it was 237 in “Nosr Areni”, 185 in “Areni Sev Clone №9”, 205 in “Areni Sev Clone №15”, and 222 in “Areni Sev Clone berqatu”. The weight of seeds per 100 berries was highest in “Areni Sev Clone №15” (13.5 *g*) followed by “Areni Sev Clone berqatu” (13.1 *g*), “Areni Sev Clone №9” (12.7 *g*), “Nosr Areni” (12.6 *g*), and the “Areni Sev” variety (11.6 *g*). As shown in Table 4, the maximum weight for 100 berries was recorded in “Areni Sev Clone №15” (239.6 *g*), followed by “Areni Sev Clone №9” (226.4 *g*), “Areni Sev Clone berqatu” (216.6 *g*), the “Areni Sev” variety (206.1 *g*), and “Nosr Areni” (177.4 *g*); the maximum weight for 100 seeds was recorded in “Areni Sev Clone №9” (6.9 *g*), followed by “Areni Sev Clone №15” (6.6 *g*), “Areni Sev Clone berqatu” (5.9 *g*), the “Areni Sev” variety (5.4 *g*), and “Nosr Areni” (5.3 *g*). For technical grape varieties, the berry composition index is also of significant importance. The highest value was observed in “Nosr Areni” (7.59) followed by the “Areni Sev” variety

(5.46), “Areni Sev Clone berqatu” (5.22), “Areni Sev Clone №9” (4.19), and the lowest in “Areni Sev Clone №15” (3.64).

During grape processing, particular attention is also paid to the ratio of berries to the rachis.

The structure of the grape cluster is characterized by the composition of its constituent parts rachis, skin, seeds, peduncle, pulp, juice and their percentage ratios, which vary depending on the grape variety, ripeness stage, ecological factors, and climatic conditions.

The parameters of the individual components of the “Areni Sev” grape variety and its clones are presented in Table 4.

Table 4

Berry composition of the “Areni Sev” Grape variety and its clones

Grape Variety and Clones	Mass, *g*		Number of seeds in 100 berries, *n*	Weight of 100 berries, *G*			Berry composition index
	100 berries	100 seeds		Seed	Skin	Pulp+juice	
Areni Sev	206,1	5,4	215	11,6	30,1	164,4	5,46
Nosr Areni	177,4	5,3	237	12,6	20,3	154,1	7,59
Areni Sev clone №9	226,4	6,9	185	12,7	41,2	172,5	4,19
Areni Sev Clone №15	239,6	6,6	205	13,5	48,7	177,4	3,64
Areni Sev clone berqatu	216,6	5,9	222	13,1	32,7	170,8	5,22

According to the research results, in the clusters of the “ Areni Sev ” grape variety, the peduncle content was 4.8% and the skin content 15.10%. In the “Nosr Areni” clone, these values were 3.5% and 11.76%, in “ Areni Sev Clone №9” 4.2% and 10.98%, in “Areni Sev Clone №15” 3.7% and 17.01%, and in “Areni Sev Clone berqatu”3.9% and 14.48%, respectively. Table 5 shows that the highest skin content was observed in the “ Areni Sev Clone №15”, while the peduncle content was highest in the “Areni Sev” variety. The seed content was highest in the “Areni Sev” variety (3.81%), followed by “ Areni Sev Clone berqatu” (3.79%), “Nosr Areni” (3.78%), “Areni Sev Clone №15” (3.44%), and “Areni Sev Clone №9” (3.38%). For technical grape varieties, the percentage of pulp plus juice is a particularly important indicator. This value was highest in the “Areni Sev Clone

№9” (81.49%) followed by the “Nosr Areni” clone (80.95%), “Areni Sev Clone berqatu” (77.86%), the “ Areni Sev ” variety (76.25%), and “Areni Sev Clone №15” (75.90%). Almost all clones exceeded the “Areni Sev” variety in this respect. The mass of the cluster skeleton was highest in the “Areni Sev Clone №15” (24.1%) followed by the “Areni Sev” variety (23.75%), “Areni Sev Clone berqatu” (22.14%), “Nosr Areni” (19.05%), and “Areni Sev Clone №9” (18.51%). Notably, the lower the skeleton mass, the higher the proportion of pulp. The cluster composition index is determined as the ratio of pulp plus juice to the skeleton mass. For the “Areni Sev” grape variety, the cluster composition index was 3.21; in “Nosr Areni”, it was 4.25; in “Areni Sev Clone №9”, it was 4.41; in “Areni Sev Clone №15”, 3.15; and in “ Areni Sev Clone berqatu”, 3.52.

Table 5

Bunch composition indicators

Grape variety and clones	Composition of individual parts in the bunch, %					Bunch composition index
	Stem	Skin	Seed	Hard residue	Pulp+juice	
Areni Sev	4,8	15,10	3,81	23,75	76,25	3,21
Nosr Areni	3,5	11,76	3,78	19,05	80,95	4,25
Areni Sev clone №9	4,2	10,98	3,38	18,51	81,49	4,41
Areni Sev clone №15	3,7	17,01	3,44	24,1	75,90	3,15
Areni Sev clone berqatu	3,9	14,48	3,79	22,14	77,86	3,52

Conclusion. The clonal selection of the “Areni Sev” grape variety has led to significant improvements in the agrobiological characteristics of its clones, where “Nosr Areni” and “Areni Sev Clone №9” exhibit superior cluster structural indices, higher pulp-juice ratios, and better sugar accumulation dynamics, which enhance juice yield and wine quality, also serving as distinctive features of the clones. The differences in mechanical composition, such as berry count, seed weight, and cluster proportions, highlight the impact of genetic mutations on productivity, allowing targeted propagation of clones like “berqatu”, for faster ripening in Armenian climatic conditions. According to the research, the cluster composition index of the “Areni Sev” grape variety and its clones is determined by the content of pulp and juice, where the higher the ratio of pulp plus juice to skeleton mass, the

greater the cluster composition index and the higher the juice yield, also serving as a distinctive feature of the clone. The cluster composition index of the "Areni Sev" grape variety was 3.21, in "Nosr Areni" 4.25, in "Areni Sev Clone №9" 4.41, in " Areni Sev Clone №15" 3.15, and in "Areni Sev Clone berqatu" 3.52. Based on the obtained data, the clones of "Areni Sev" can be used in winemaking, as the studied clones are promising for the production of high-quality wines, with ongoing discovery of their potential.

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«ԱՐԵՆԻ ՍԵՎ» ԽԱՂՈՂԻ ՍՈՐՏԻ ԵՎ ԴՐԱ ԿԼՈՆՆԵՐԻ ՄԵԽԱՆԻԿԱԿԱՆ ԿԱԶՄԻ ԵՎ ՖԻԶԻԿԱՔԻՄԻԱԿԱՆ ՑՈՒՑԱՆԻՇՆԵՐԻ ԴԻՆԱՄԻԿԱՅԻ ՀԱՄԵՄԱՏԱԿԱՆ ՎԵՐԼՈՒԾՈՒԹՅՈՒՆ

Ա.Կ. Սոլոմոնյան

Սույն հետազոտությունը նվիրված է «Արենի Սև» խաղողի սորտի և դրա կլոնների (Նոսր Արենի, Արենի Սև կլոն №9, Արենի Սև կլոն №15 և Արենի Սև կլոն Բերքատու) մեխանիկական կազմի և ֆիզիկաքիմիական ցուցանիշների դինամիկայի համեմատական ուսումնասիրություն: Հետազոտություններն իրականացվել են 2024-2025 թթ. Արմավիրի մարզի Էջմիածնի տարածաշրջանում գտնվող խաղողի ազգային կոլեկցիոն այգում:

Ուսումնասիրվել են շաքարի պարունակության, տիտրվող թթվայնության և pH-ի դինամիկան, ինչպես նաև ողկույզի և պտուղների կառուցվածքային և կազմության ցուցանիշները՝ ըստ Ն.Ն. Պրոստոսերդովի մեթոդաբանության:

Ստացված արդյունքները ցույց են տվել, որ կլոնային ընտրությունը զգալիորեն բարելավում է Արենի Սև սորտի ագրոբիոլոգիական և տեխնոլոգիական հատկությունները: Մասնավորապես, Նոսր Արենին և Արենի Սև կլոն №9-ը առանձնանում են ողկույզի կառուցվածքային բարձր ցուցանիշներով, պտղամիս+պտղահյութի մեծ հարաբերակցությամբ և շաքարի կուտակման ավելի ինտենսիվ դինամիկայով: Ողկույզի կազմության ցուցանիշը Սև Արենի սորտում կազմել է 3,21, իսկ առավելագույն արժեքները գրանցվել են Արենի Սև կլոն №9-ում (4,41) և Նոսր Արենիում (4,25):

Մեխանիկական կազմի տարբերությունները՝ պտուղների քանակի, սերմերի զանգվածի և կմախքային մասի հարաբերակցության տեսանկյունից, վկայում են գենետիկական մուտացիաների ազդեցության մասին արտադրողականության և հյութի ելքի վրա: Ստացված տվյալները հաստատում են, որ ուսումնասիրված կլոնները հեռանկարային են բարձրորակ գինիների արտադրության համար և կարող են նպատակային կերպով կիրառվել հայկական կլիմայական պայմաններում գինեգործության արդյունավետության բարձրացման նպատակով:

Առանցքային բառեր. «Արենի Սև», «Արենի Սև կլոն №15»,մեխանիկական կազմ, խաղողի սորտ և կլոններ, կլոնային ընտրություն, ֆիզիկաքիմիական ցուցանիշների դինամիկա:

СРАВНИТЕЛЬНЫЙ АНАЛИЗ МЕХАНИЧЕСКОГО СОСТАВА И ДИНАМИКИ ФИЗИКО-ХИМИЧЕСКИХ ПАРАМЕТРОВ СОРТА ВИНОГРАДА “АРЕНИ СЕВ” И ЕГО КЛОНОВ

А.К. Соломонян

В рамках данного исследования проведён сравнительный анализ механического состава и динамики физико-химических показателей сорта винограда “Арени Сев” и его клонов: “Носр Арени”, “клон №9 Арени Сев”, “клон №15 Арени Сев ” и “клон Беркату Арени Сев”. Исследования выполнены в 2024–2025 гг. в Национальном коллекционном винограднике, расположенном в Эчмиадзинском районе Армавирской области Армении.

Изучены динамика накопления сахара, титруемой кислотности и pH, а также структурные и композиционные показатели гроздей и ягод в соответствии с методикой Н.Н. Простосердова.

Полученные результаты показали, что клоновая селекция существенно улучшает агробиологические и технологические свойства сорта “Сев Арени”. В частности, клоны “Носр Арени” и “клон №9 Арени Сев” выделяются высокими структурными показателями грозди, повышенным соотношением мякоти и сока, а также более интенсивной динамикой накопления сахара. Индекс состава грозди для сорта “Арени Сев” составил 3,21, максимальные значения зафиксированы у клона “клон №9 Арени Сев ” (4,41) и “Носр Арени” (4,25).

Различия в механическом составе (по количеству ягод, массе семян и доле скелетной части) свидетельствуют о влиянии генетических мутаций на продуктивность и выход сока. Полученные данные подтверждают, что изученные клоны перспективны для производства высококачественных вин и могут целенаправленно применяться для повышения эффективности виноделия в климатических условиях Армении.

Ключевые слова: “Арени Сев”, “клон №15 Арени Сев”, механический состав, сорт винограда и его клоны, клоновая селекция, динамика физико-химических показателей.