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A Comparative Study of Anatomical and Chemical Characteristics of Some Local Grapevine Cultivars (*Vitis vinifera* L.) Grown in Northern Iraq

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Abstract

The current research conducted a comparative study of the anatomical and chemical characteristics of nine (9) local grapevine cultivars (*Vitis vinifera* L.) cultivated in northern Iraq, namely: Sarkoula, Shadda Bayda, Beidhawi, Muscat Sebi, Sloobi, Rashmio, Faleen Turki, Bakira Black, and Zah-r Bakira. The anatomical study included the characterization of the leaves in terms of the shape and dimensions of the upper and lower epidermal cells, surface covering, stomata, and the stomatal complex, which was of the anomocytic type. It was observed that stomata were present exclusively on the lower surface (hypostomatic). The venation system in the leaf was of the palmate-reticulate type across all studied cultivars. On the chemical side, phenolic and alkaloid compounds were identified using High-Performance Liquid Chromatography (HPLC) by extracting them from the leaves during the flowering period. Five (5) phenolic compounds were identified, namely: Apigenin, Kaempferol, Quercetin, 2,6-Dimethylphenol, and Gallic acid, in addition to one alkaloid compound, Caffeine. The quantitative and qualitative estimation of these compounds confirmed their significance as reliable chemotaxonomic markers in distinguishing and isolating the studied cultivars from one another.

دراسة مقارنة للخصائص التشريحية والكيميائية لبعض أصناف العنب المحلية (Vitis vinifera L.) المزروعة في شمال العراق

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ملخص

أجرى البحث الحالي دراسة مقارنة للخصائص التشريحية والكيميائية لتسعة (9) أصناف محلية من العنب (Vitis vinifera L.)تُزرع في شمال العراق، وهي: سركولا، وشدا بيضاء، وبيضاوي، ومسقط سبي، وسلوبي، ورشميو، وفلين تركي، وباكيرة السوداء، وزهر باكيرة. شملت الدراسة التشريحية توصيف الأوراق من حيث شكل وأبعاد خلايا البشرة العلوية والسفلية، والغطاء السطحي، والثغور، ومركب الثغور الذي كان من النوع غير المنتظم. لوحظ أن الثغور موجودة حصريًا على السطح السفلي (السطح السفلي). كان نظام التعرق في الورقة من النوع الكفي الشبكي في جميع الأصناف المدروسة. أما من الناحية الكيميائية، فقد تم تحديد المركبات الفينولية والقلويدية باستخدام كروماتوغرافيا السائل عالي الأداء (HPLC) عن طريق استخلاصها من الأوراق خلال فترة الإزهار. تم تحديد خمسة

(5) مركبات فينولية، وهي: أبيجينين، وكايمبفيرول، وكيرسيتين، و6،2-ثنائي ميثيل فينول، وحمض الغاليك، بالإضافة إلى مركب قلوي واحد هو الكافيين. وقد أكد التقدير الكمي والنوعي لهذه المركبات أهميتها كعلامات تصنيفية كيميائية موثوقة في تمييز وعزل الأصناف المدروسة عن بعضها البعض.

1. Introduction

The diversity and variations among living organisms, particularly plants, have necessitated efforts to uncover, describe, and interpret these differences. Morphological, anatomical, and phytochemical characteristics are considered vital aspects that facilitate the identification and classification of wild and cultivated species, especially those of economic importance that constitute a significant part of a nation's natural wealth [2].

The grapevine, *Vitis vinifera* L., is a fruit species of high nutritional and economic value. It exhibits a wide geographical distribution across temperate and semi-arid regions, particularly in tropical and subtropical zones throughout Asia, Africa, and the Americas. This species encompasses more than 950 cultivars [2]. Its fruits are rich in sugars, vitamins, proteins, lipids, and organic acids [3].

Cultivars are classified into four major groups based on production objectives these are

1- Table Grapes: Including *Bahrezi*, *Abbasi*, *Kamali*, *Halwani*, *Deis Al-Anz*, *Beidh Al-Hamam*, *Taifi*, *Mirani*, and others. 2- Raisin Grapes: Including seeded varieties such as *Hiyah*, *Sakaat Al-Askaniya*, *Trarash*, and *Razqi*; and seedless varieties such as *Kishmishi*, *Korinth*, *Perlette*, and others. 3- Wine Grapes: Such as *Furmint*, *Semillon*, and *Pinot Gris*. and 4- Sweet Juice Grapes: Such as *Zark*, *Warka*, *Sloobi*, and others [4].

Data and evidence derived from anatomical studies provide an additional foundation for taxonomy, often supporting morphological, cytological, phytochemical, and ecological traits. Most anatomical features are regarded as Diagnostic Features, utilized in delimiting taxonomic ranks at the genus, species, and variety levels [5]. These include the leaf anatomy, upper epidermal cell structure, internal leaf configuration, and the xylem anatomy of both vegetative and reproductive organs. Furthermore, anatomical traits frequently bolster morphological descriptions and hold significant weight in modern taxonomic studies [6].

The importance of leaf anatomy—specifically stomatal distribution, stomatal index, and the thickness of the upper and lower epidermis—in distinguishing between two grapevine cultivars, *Grenache Noir* and *Syrah*, where distinct morphological and anatomical variations were observed [7].
Chemical constituents in plants play an effective role in nature by determining the flavor and palatability of the tissues in which they occur. In many instances, species and varieties can be distinguished by their taste, independent of other characteristics. That phenolic compounds are among the most well-known and widely utilized chemical substances in taxonomy due to their ubiquitous presence in leaves, flowers, fruits, seeds, wood, and bark [6, 8].

Chemical properties serve as indicators of the relationships between various taxonomic ranks and show high correlation with morphological and anatomical traits. They are crucial in delineating broad relationships between taxa, though they should not be relied upon as taxonomic evidence in isolation from other criteria [9]. Among the chemical compounds that have garnered significant attention from taxonomists are phenols, including flavonoids and alkaloids, being products of secondary metabolism. Due to their high concentrations in plants, structural diversity, ease of extraction, and their medical and

economic importance [10], these compounds—found in leaves, flowers, fruits, and seeds—are essential for evaluating evolutionary relationships [11, 12].

Recent phytochemical studies on phenolic compounds [13], have identified numerous phenolic constituents in the seeds and leaves of various grapevine cultivars.

The objective of this study is to com pare anatomical and Chemical characteristics between the Local cultivars of the grapevine (*Vitis vinifera* L.) grown in Northern of Iraq**.**

2. Materials and Methods

2.1. Sample Collection

Samples were collected from nine local grapevine cultivars: (*Sarkoula, Shadda Beidha*, *Beidhawi*, *Sloobi*, *Rashmio, Faleen Turki*, *Bakira Black,* and *Zah-r Bakira*). These cultivars are widely cultivated in northern Iraq. The samples were obtained from the nursery of the Department of Horticulture and Landscape Design, College of Agriculture and Forestry, University of Mosul, for the purpose of investigating their anatomical and phytochemical characteristics.

2.2. Anatomical Study

2.2.1. Epidermal Preparation

The study utilized fresh leaf samples to examine epidermal cells, including their dimensions, trichomes, stomata, and stomatal index, following the method described by [14]. Due to the thinness of the leaves and the difficulty of traditional peeling, the Replica Method was employed. Clear nail polish was applied to both the adaxial (upper) and abaxial (lower) surfaces. After a drying period of (1–3) minutes, clear adhesive tape was applied over the film and then peeled off, carrying a precise impression of the epidermis. The tape was mounted onto glass slides and examined under a compound light microscope. Images were captured using a high-resolution mobile camera. Measurements for epidermal cells and stomatal dimensions were recorded using a (7x) ocular lens and a (40x) objective lens. The Stomatal Index (SI) was calculated according to [15] using the following formula:

SI = \left(\frac{S}{S + E} \right) \times 100

Where:

- **S**: Number of stomata per unit area.
- **E**: Number of epidermal cells in the same area.

2.2.2. Leaf Clearing

Leaf samples were placed in Petri dishes containing a 3% Sodium Hydroxide (NaOH) solution for 15–20 days. The solution was periodically replaced until the mesophyll tissue was completely decolorized. The leaves were then washed several times with distilled water to remove residual alkali. Subsequently, they were transferred to Petri dishes containing 1% Safranin stain (prepared in 70% ethyl alcohol) for 30 seconds. Excess stain was removed by washing with 70% ethyl alcohol, followed by absolute alcohol. Finally, the cleared leaves were mounted on clean glass slides using glycerin and covered with coverslips for microscopic examination.

2.3. Phytochemical Study

2.3.1. Preparation of Crude Alcoholic Extracts

The ethanolic extract was prepared following the procedure of [16]. (5) g of leaf powder from each cultivar was macerated in 50 ml of 95% Ethyl Alcohol for 48 hours. A simple extraction was performed using a separatory funnel with Chloroform to remove chlorophyll and other oil-soluble pigments. The phenolic compounds remained in the intermediate (ethanol) layer in the form of glycosides.

2.3.2. Acid Hydrolysis

Based on the method of [17], 2 g of the alcoholic extract was dissolved in 200 ml of 2 M Hydrochloric Acid (HCl). The mixture was heated in a water bath at (90–100) °C for 30 minutes with continuous stirring. After cooling, the mixture was extracted with Ethyl Acetate (100 ml x 2) using a separatory funnel to isolate the aglycones.

2.3.3. Identification of Phenolic and Alkaloid Compounds via High-Performance Liquid Chromatography (HPLC)

Standard samples and plant extracts were filtered through a 0.45 µm membrane filter prior to analysis. The identification was performed using a Shimadzu (Japan) HPLC system equipped with a Phenomenex $_{18}$C_{18} column (100Å, 250 × 60 mm). The mobile phase consisted of a Methanol:Water mixture at a volume ratio of (80:20 v/v). To ensure optimal separation, the mobile phase was filtered and degassed using an ultrasonic sonicator.

The flow rate was maintained at 1 ml/min, and detection was carried out at a wavelength of 280 nm. An injection volume of 20 µl was used for both the standard compounds (phenols and alkaloids) and the samples. The identification of compounds isolated from the ethyl acetate-soluble extracts was based on a comparison of their retention times ($_t$R) with those of the standards [16].

3. Results

3.1. Anatomical Study

3.1.1. General Epidermal Cells

The ordinary epidermal cells of both the adaxial (upper) and abaxial (lower) surfaces in all studied cultivars were characterized as simple and uniseriate (single-layered). Their shapes ranged from polygonal to oblong. The study revealed variation in the configuration and dimensions of the internal and external tangential walls between the two surfaces; the adaxial epidermis and abaxial epidermis exhibited straight to straight-curved walls, while the abaxial epidermis showed straight to curved-undulate walls across all cultivars

The epidermal cell dimensions displayed significant variation, as shown in Table (1) and Figure (1), with ranges of (20–56 µm) for the adaxial surface and (10–42 µm) for the abaxial surface. Regarding the foliar appendages, the surface was covered with non-glandular, unicellular, unbranched, and straight trichomes. Furthermore, prismatic crystals were observed in clusters within the epidermal cells of both surfaces.

3.1.2. Stomatal Complexes

All studied cultivars exhibited a single stomatal type: the Anomocytic type (also known as the Ranunculaceous type). This pattern is characterized by the absence of specialized subsidiary cells, where the stoma is surrounded by (3–5) ordinary epidermal cells. The leaves were confirmed to be Hypostomatic, as stomata were entirely absent on the adaxial surface and confined to the abaxial surface. The stomatal shape varied between elliptical and oblong, while the guard cells surrounding the stomatal pore were reniform (kidney-shaped) in all cultivars. However, the stomatal density (number of stomata per microscopic field of view) varied significantly among the studied cultivars.

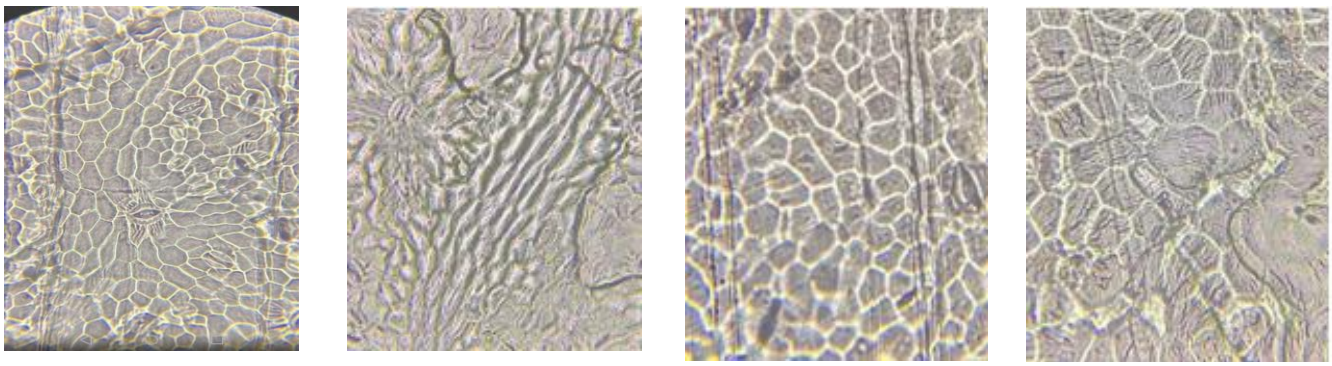
3.1.3. Leaf Venation

The investigation showed that the venation system in all studied cultivars is of the Palmately Reticulate type. In this pattern, several primary veins of equal size radiate from the point where the petiole meets the lamina, spreading like the fingers of a hand. Secondary and tertiary veins branch out from these primaries, interweaving throughout the blade, with the main veins extending toward the leaf margin. The areoles (the small spaces formed by the vein network) were irregular in shape, appearing triangular, square, or branched. The veinlets within these areoles were inconsistent in shape across the cultivars, as illustrated in Figure (2).

Table 1. Quantitative and Qualitative Variations in Adaxial and Abaxial Leaf Epidermal Cell Walls and Stomatal Complexes of the Studied Grapevine Cultivars (Measurements in µm).

No	Cultivars	Epidermal Cell Dimensions			Stomatal Dimensions			Abaxial Cell Walls	Adaxial Cell Walls
		Length (L)	Width (W)	Average (L × W)	Stomatal Index	Length	Width		
1	Sarkoula	(55 - 20) 39.7	(42 - 10) 23.1	X 39.7 23.1	4.80	(11 – 5) 8.8	(8 – 4) 5.8	Straight-Undulate	Straight-Curved
2	Shadda Beidha	(53 - 25) 38.2	(42 - 12) 21.8	X 38.2 21.8	5.20	(12 – 5) 8.1	(11 – 5) 7	Straight-Undulate	Straight-Curved
3	Beidhawi	(56 - 28) 40.5	(38 - 12) 23.0	X 40.5 23.0	4.56	(10 – 7) 8.5	(8 – 4) 5.8	Straight-Curved	Straight-Curved
4	Muscat Sebi	(55 - 27) 39.3	(35 - 13) 22.4	X 39.3 22.4	5.81	(10 – 6) 7.9	(9 – 4) 5.6	Straight-Undulate	Straight-Undulate
5	Sloobi	(55 - 22) 37.8	(33 - 13) 20.6	X 37.8 20.6	5.29	(12 – 6) 8.4	(8 – 4) 6.2	Straight-Undulate	Straight-Curved
6	Rashmio	(52 - 20) 37.0	(32 - 15) 21.7	X 37.0 21.7	5.43	(9 – 6) 6.8	(6 – 3) 4.1	Straight-Curved	Straight-Curved
7	Faleen Turki	(49 - 30) 38.2	(35 - 12) 24.4	X 38.2 24.4	5.78	(9 – 5) 6.9	(8 – 4) 4.5	Straight-Undulate	Straight-Undulate
8	Bakira Black	(50 - 25) 38.2	(33 - 18) 22.8	X 38.2 22.8	6.21	(11 – 6) 8.6	(6 – 4) 6.6	Straight-Curved	Straight-Curved
9	Zah-r Bakira	(50 - 25) 37.1	(28 - 15) 22.6	X 37.1 22.6	5.84	(10 – 7) 8.6	(10 – 4) 7.6	Straight-Curved	Straight-Undulate

Note: Numbers within parentheses represent the minimum and maximum limits, while numbers outside parentheses represent the mean (average).



B- LowerEpiderma cell A-UpperEpiderma cell

Figure 1. Morphological patterns of epidermal cells and stomatal complexes in the studied grapevine leaves.

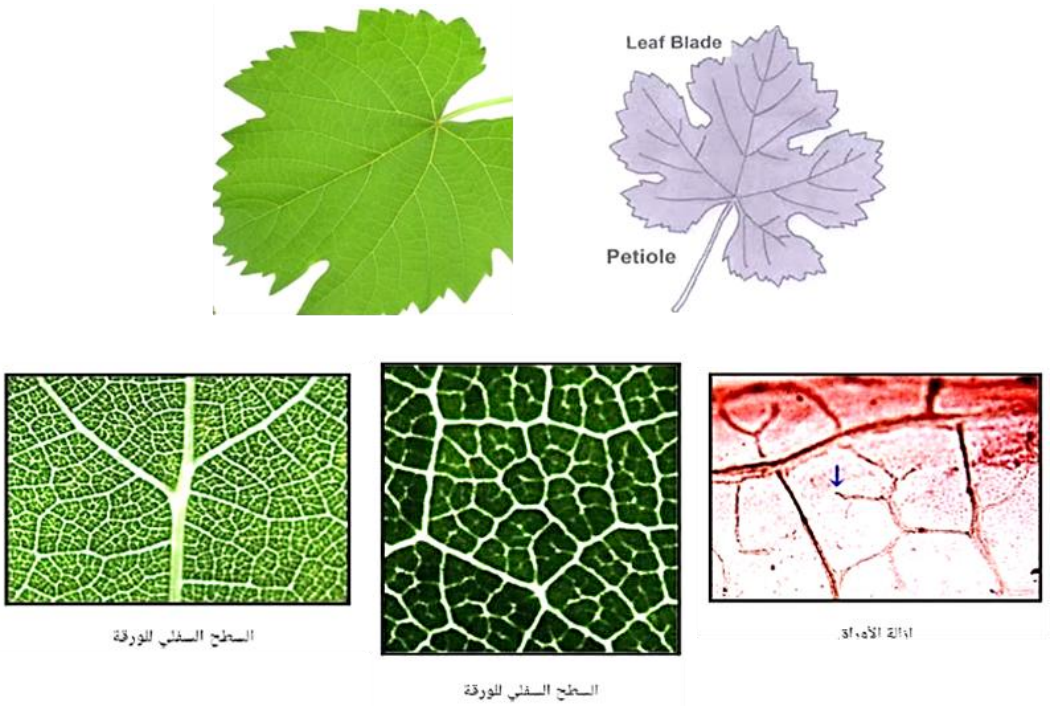


Figure 2. Leaf venation patterns in the studied grapevine cultivars.

3.4. Phytochemical Study

The results of the **High-Performance Liquid Chromatography (HPLC)** analysis of the leaf extracts from the studied grapevine cultivars revealed significant variations in the presence and concentration of phenolic and alkaloid compounds. Based on the standard reference compounds, five phenolic compounds and one alkaloid were identified, as detailed in **Tables (2, 3, 4)** and **Figures (3, 4, 5, 6, 7, 8, 9)**. These compounds are:

1. **Apigenin:** This flavonoid compound was detected in all studied cultivars.
2. **2,6-Dimethylphenol:** This compound was present in all cultivars except for *Sarkoula* and *Shadda Beidha*.
3. **Gallic acid:** This phenolic acid was identified in all studied cultivars.
4. **Kaempferol:** A flavonoid that appeared in five cultivars (*Sarkoula*, *Beidhawi*, *Muscat Sebi*, *Sloobi*, and *Rashmio*) and was absent in the remaining cultivars.
5. **Quercetin:** This compound was recorded in all cultivars except for *Shadda Beidha* and *Faleen Turki*.

Caffeine: An alkaloid compound that was present in (*Sarkoula*, *Beidhawi*, *Sloobi*, *Faleen Turki*, and *Bakira Black*) and was not detected in the other cultivars.

Table 2. Retention Times (tR) of Standard Compounds..

No.	Standard Compounds	Standard Retention Time ($_t$R, min)
1	Apigenin	3.044
2	2,6-Dimethylphenol	6.855
3	Gallic acid	4.028
4	Kaempferol	7.925
5	Quercetin	4.839
6	Caffeine	5.790

Table 3. Distribution (Presence/Absence) of Phenolic and Alkaloid Compounds in the Studied Grapevine Cultivars.

No.	Scientific / Cultivars	Apigenin	-6 ,2 Dimethylphenol	Gallic acid	Kaempferol	Quercetin	Caffeine
1	**Sarkoula**	+	-	+	+	+	-
2	**Shadda Beidha**	+	-	+	-	-	-
3	**Beidhawi**	+	+	+	+	+	+
4	**Muscat Sebi**	+	+	+	+	+	-
5	**Sloobi**	+	+	+	+	+	+
6	**Rashmio**	+	+	+	-	+	-
7	**Faleen Turki**	+	+	+	+	-	+
8	**Bakira Black**	+	+	+	-	+	+
9	**Zah-r Bakira**	+	+	+	-	+	-

Table 4. Comparative Retention Times (tR) of Identified Phenolic and Alkaloid Compounds Across the Studied Grapevine Cultivars.

No.	Scientific / Cultivars	Apigenin	2,6 - Dimethylphenol	Gallic acid	Kaempferol	Quercetin	Caffeine
	Standard $_t$R (min)	3.044	6.855	4.028	7.925	4.839	5.790
1	Sarkoula	3.031	—	4.196	7.742	4.763	—
2	Shadda Beidha	3.030	—	4.191	—	—	—
3	Beidhawi	3.027	6.829	4.258	7.835	4.834	5.600
4	Muscat Sebi	3.014	6.863	4.178	7.917	4.782	____
5	Sloobi	3.015	6.930	4.133	7.860	4.771	5158
6	Rashmio	3.039	6.715	4.269	—	4.700	—
7	Faleen Turki	3-112	6.592	4.195	7.808	—	5.426
8	Bakira Black	3.013	6.844	4.164	—	4.734	5.229
9	Zah-r Bakira	3.010	6.883	4.180	—	4.421	—

Note: (—) indicates the absence of the compound in the cultivar. All values are expressed as retention time ($_t$R) in minutes.

3.5. Concentration of Phenolic and Alkaloid Compounds

The concentrations of the identified compounds in the leaf extracts varied significantly across the studied grapevine cultivars, as summarized in Table (5).

- Apigenin: The highest concentration was recorded in the cultivar 'Faleen Turki' at 58.49 ppm, while the lowest concentration was found in 'Zah-r Bakira' at 9.4 ppm.

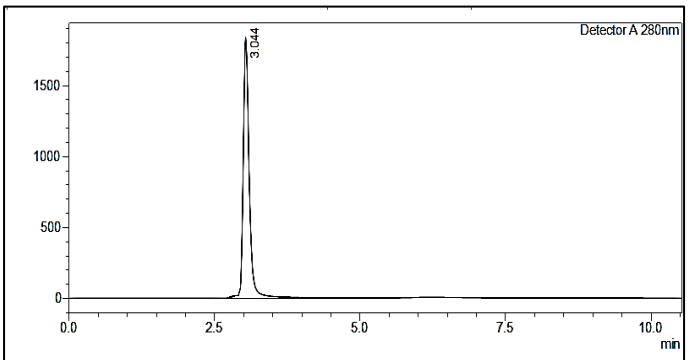
- 2,6-Dimethylphenol: This compound reached its maximum concentration of 10.80 ppm in the 'Beidhawi' cultivar, whereas the minimum concentration of 0.01 ppm was observed in 'Zah-r Bakira'.
- Gallic Acid: The peak concentration was noted in 'Shadda Beidha' at 15.67 ppm, while the lowest value was recorded in 'Muscat Sebi' at 0.10 ppm.
- Kaempferol: The cultivar 'Beidhawi' yielded the highest concentration of 42.20 ppm, while the lowest concentration was detected in 'Muscat Sebi' at 0.46 ppm.
- Quercetin: The maximum concentration was documented in 'Sarkoula' at 84.62 ppm, and the minimum was in 'Zah-r Bakira' at 0.64 ppm.
- Caffeine (Alkaloid): The highest concentration was registered in the 'Sloobi' cultivar at 10.69 ppm, while the lowest concentration was found in 'Bakira Black' at 3.07 ppm.

Table 5. Concentrations of identified phenolic and alkaloid compounds in the studied grapevine cultivars (ppm).

No.	Scientific / Cultivars	Apigenin	2,6-Dimethylphenol	Gallic acid	Kaempferol	Quercetin	Caffeine
1	Sarkoula	15.48	—	5.91	9.64	84.62	—
2	Shadda Beidha	11.36	—	15.67	—	—	—
3	Beidhawi	13.79	10.80	6.25	42.20	51.19	9.29
4	Muscat Sebi	12.21	0.67	0.10	0.46	2.85	—
5	Sloobi	17.20	1.22	1.93	4.79	7.14	10.64
6	Rashmio	11.88	6.00	1.72	1.29	10.32	—
7	Faleen Turki	58.49	1.16	10.27	—	—	4.29
8	Bakira Black	13.82	0.39	2.43	—	5.88	3.07
9	Zah-r Bakira	9.4	0.01	0.66	—	0.64	—

Note: (—) indicates that the compound was not detected in the cultivar. Concentrations are measured in parts per million (ppm).

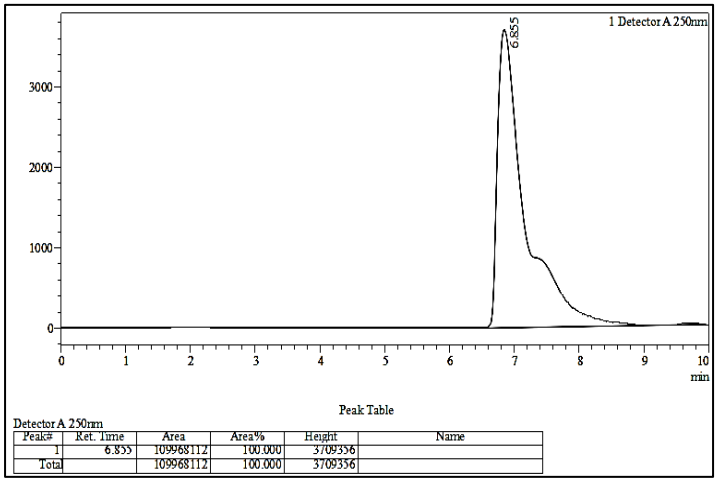
Apigenin



<Peak Table>
Detector A 280nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	3.044	13216559	1838436	100.000			
Total		13216559	1838436				

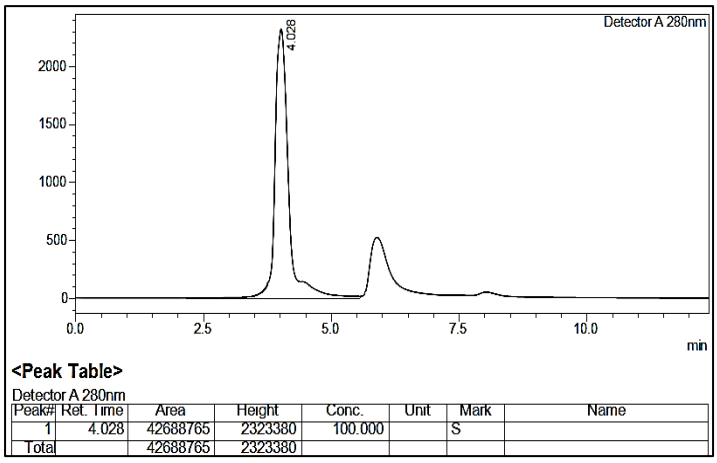
2,6-Dimethylphenol



Peak Table
Detector A 250nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	6.855	109968112	100.000	3709356	
Total		109968112	100.000	3709356	

Gallic acid

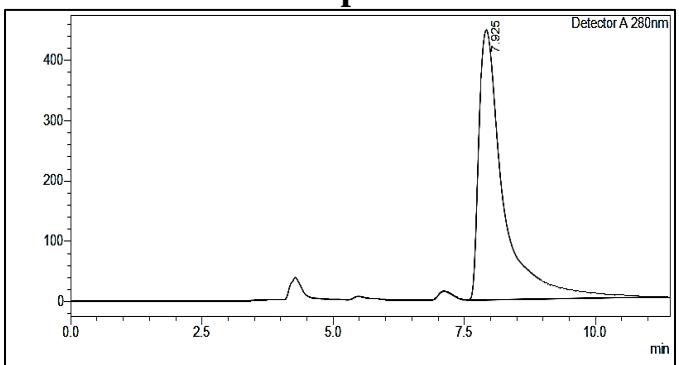


<Peak Table>
Detector A 280nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	4.028	42688765	2323380	100.000		S	
Total		42688765	2323380				

Figure 3. HPLC Chromatogram of the Standard Reference Compounds: 1. Apigenin, 2. 2,6-Dimethylphenol, 3. Gallic acid.

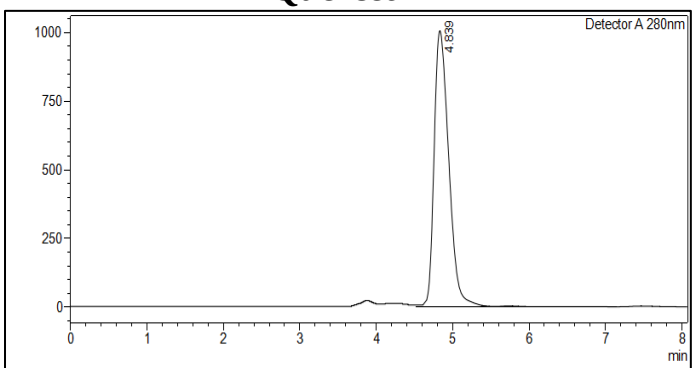
Kaempferol



<Peak Table>
Detector A 280nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.925	14701420	447562	100.000			
Total		14701420	447562				

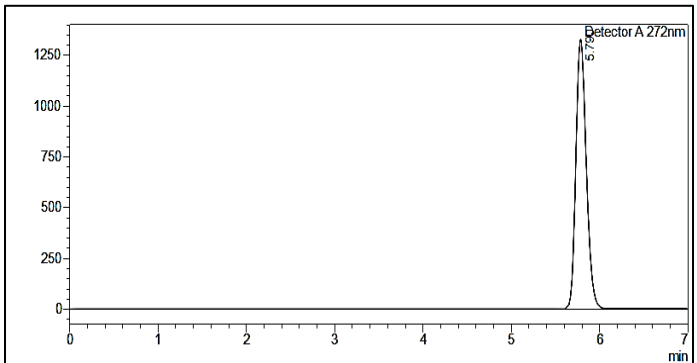
Quercetin



<Peak Table>
Detector A 280nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	4.839	13443738	1005238	100.000			
Total		13443738	1005238				

caffeine

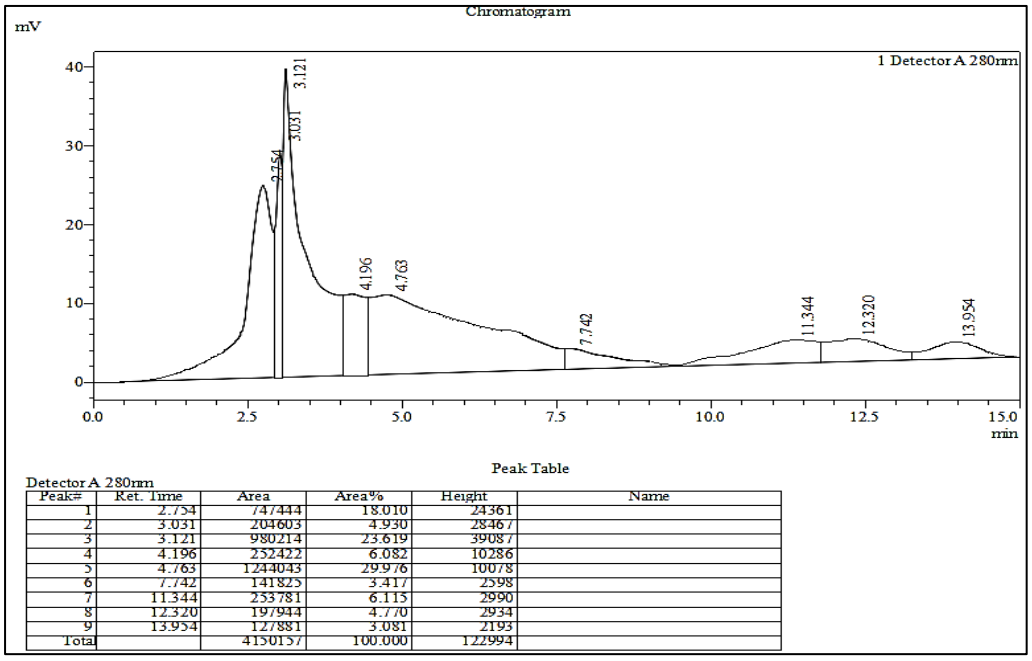


<Peak Table>
Detector A 272nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.790	10871883	1328621	261.709	PPM		caffeine
Total		10871883	1328621				

Figure 4. HPLC Chromatogram of the Standard Reference Compounds: 1. Kaempferol, 2. Quercetin, 3. Caffein.

1

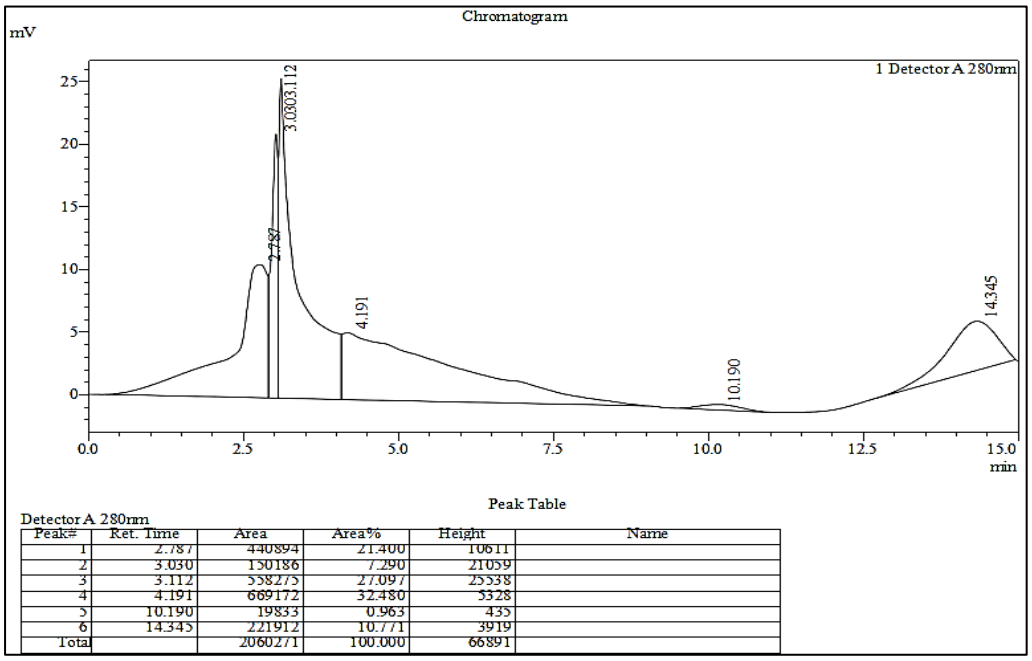


Peak Table

Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.754	747444	18.010	24361	
2	3.031	204603	4.930	28467	
3	3.121	980214	23.619	39087	
4	4.196	252422	6.082	10286	
5	4.763	1244043	29.976	10078	
6	7.742	141825	3.417	2598	
7	11.344	253781	6.115	2990	
8	12.320	197944	4.770	2934	
9	13.954	127881	3.081	2193	
Total		4150157	100.000	122994	

2



Peak Table

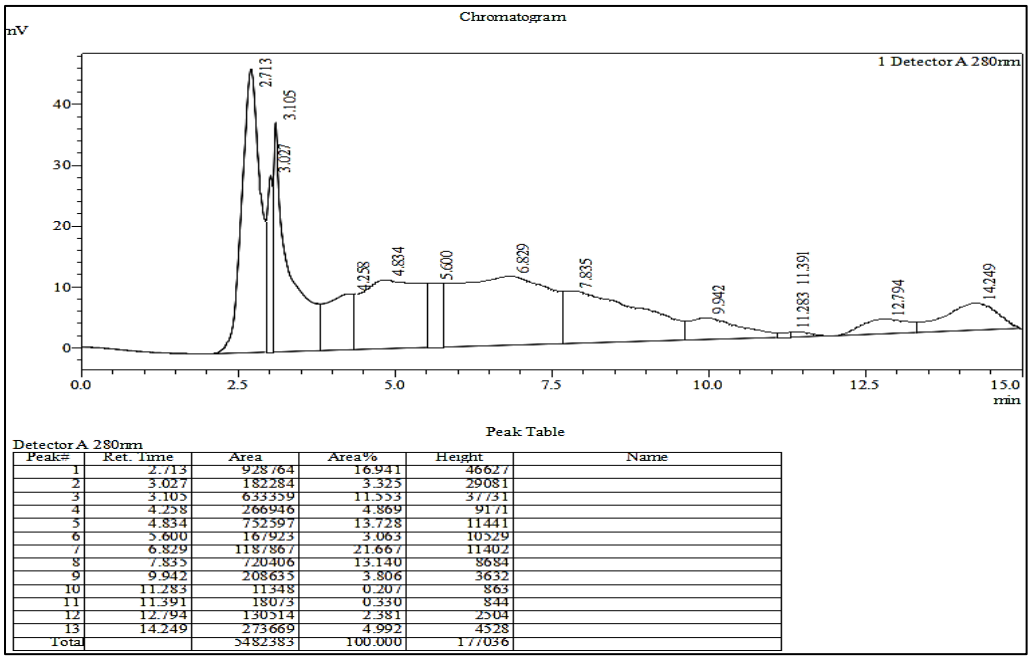
Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.787	440894	21.400	10611	
2	3.030	150186	7.290	21059	
3	3.112	558275	27.097	25538	
4	4.191	669172	32.480	5328	
5	10.190	19833	0.963	435	
6	14.345	221912	10.771	3919	
Total		2060271	100.000	66891	

Figure 5. HPLC Chromatograms of Identified Phenolic and Alkaloid Compounds for the Studied Cultivars.

1. Sarkoula, 2. Shadda Beidha.

3

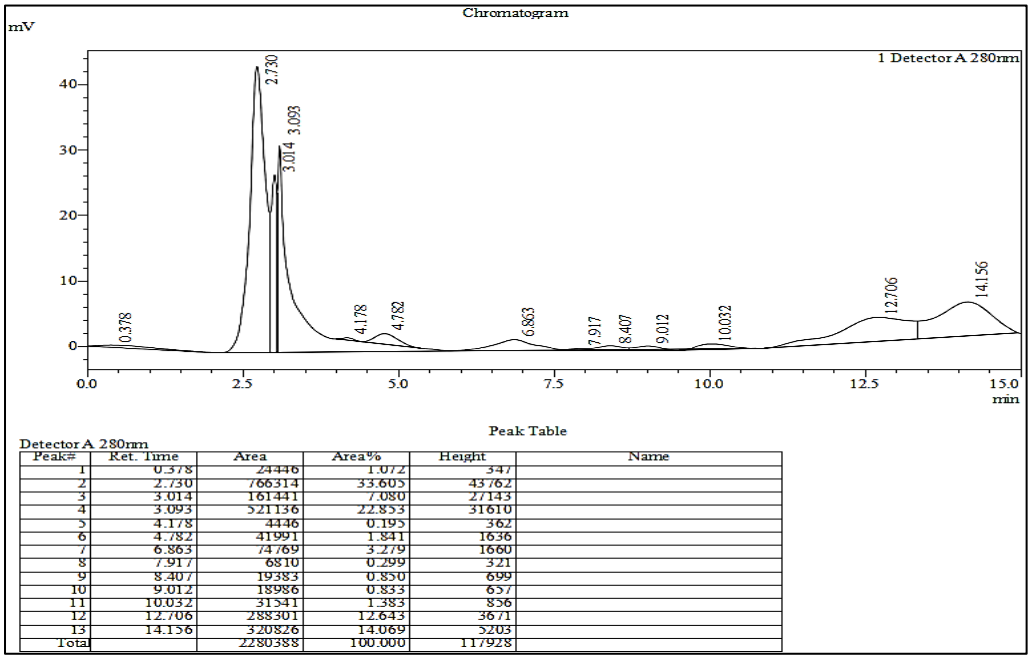


Peak Table

Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.713	928764	16.941	46627	
2	3.027	182284	3.325	29081	
3	3.105	633359	11.553	37731	
4	4.258	266946	4.869	9171	
5	4.834	752597	13.728	11441	
6	5.600	167923	3.063	10529	
7	6.829	1187867	21.667	11402	
8	7.835	720406	13.140	8684	
9	9.942	208635	3.806	3632	
10	11.283	11348	0.207	863	
11	11.391	18073	0.330	844	
12	12.794	130514	2.381	2504	
13	14.249	273669	4.992	4528	
Total		5482383	100.000	177036	

4



Peak Table

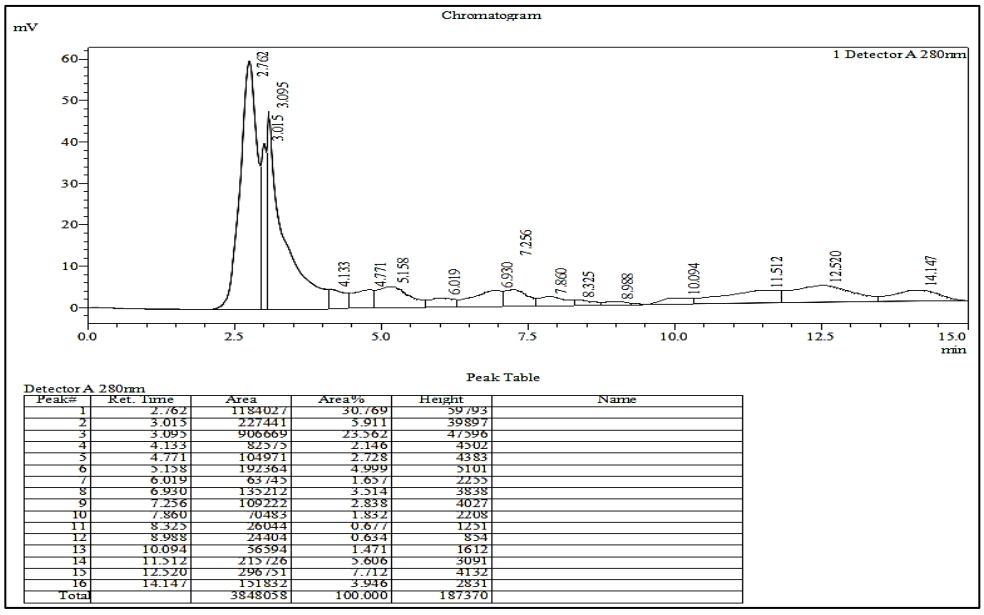
Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	0.378	24446	1.072	347	
2	2.730	766314	33.605	43762	
3	3.014	161441	7.080	27143	
4	3.093	521136	22.853	31610	
5	4.178	4446	0.195	362	
6	4.782	41991	1.841	1636	
7	6.863	74769	3.279	1660	
8	7.917	6810	0.299	321	
9	8.407	19383	0.850	699	
10	9.012	18986	0.833	657	
11	10.032	31541	1.383	836	
12	12.706	288301	12.643	3671	
13	14.156	320826	14.069	5203	
Total		2280388	100.000	117928	

Figure 6. HPLC Chromatograms of Identified Phenolic and Alkaloid Compounds for the Studied Cultivars:

3. Beidhawi, 4. Sloobi.

5

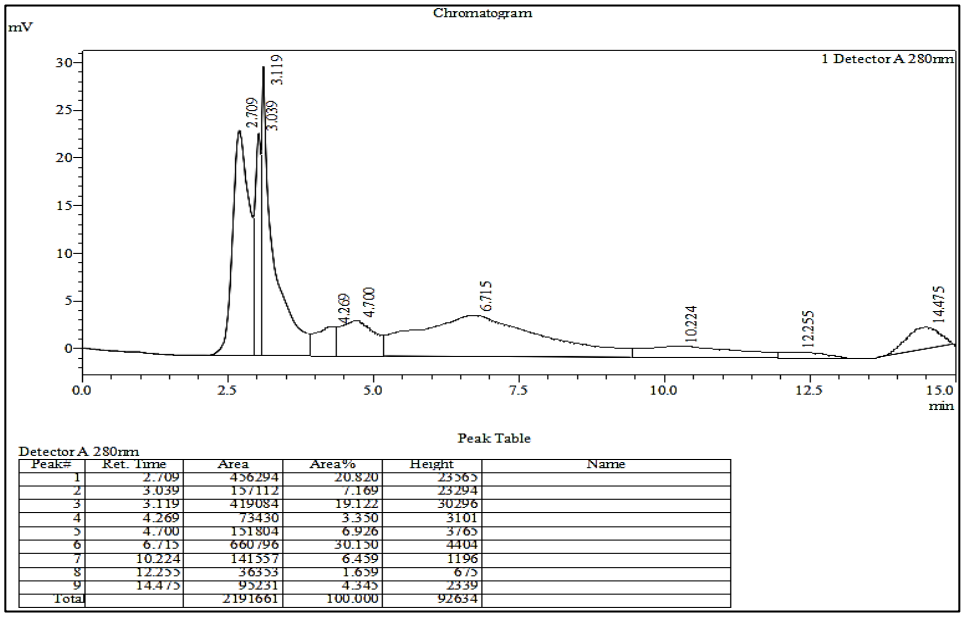


Peak Table

Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.762	1184027	30.769	59793	
2	3.015	227441	5.911	39897	
3	3.095	906669	23.562	47596	
4	4.133	82575	2.146	4502	
5	4.771	104971	2.728	4383	
6	5.158	192364	4.999	5101	
7	6.019	63745	1.657	2255	
8	6.930	135212	3.514	3838	
9	7.256	109222	2.838	4027	
10	7.860	70483	1.832	2208	
11	8.325	26044	0.677	1251	
12	8.988	24404	0.634	854	
13	10.094	56594	1.471	1612	
14	11.512	215726	5.606	3091	
15	12.520	296751	7.712	4132	
16	14.147	151832	3.946	2831	
Total		3848058	100.000	187370	

6



Peak Table

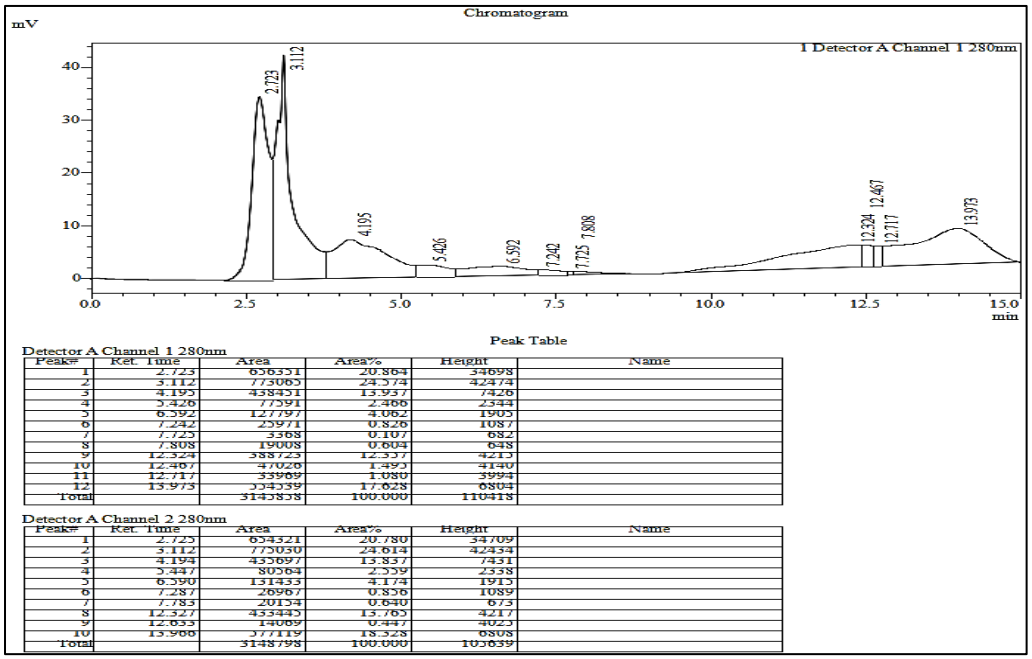
Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.709	456294	20.820	23565	
2	3.039	157112	7.169	23294	
3	3.119	419084	19.122	30296	
4	4.269	73430	3.350	3101	
5	4.700	151804	6.926	3765	
6	6.715	660796	30.150	4404	
7	10.224	141557	6.459	1196	
8	12.255	36353	1.659	675	
9	14.475	95231	4.345	2339	
Total		2191661	100.000	92634	

Figure 7. HPLC Chromatograms of Identified Phenolic and Alkaloid Compounds for the Studied Cultivars:

5. Muscat Sebi, 6. Rashmio.

7



Peak Table

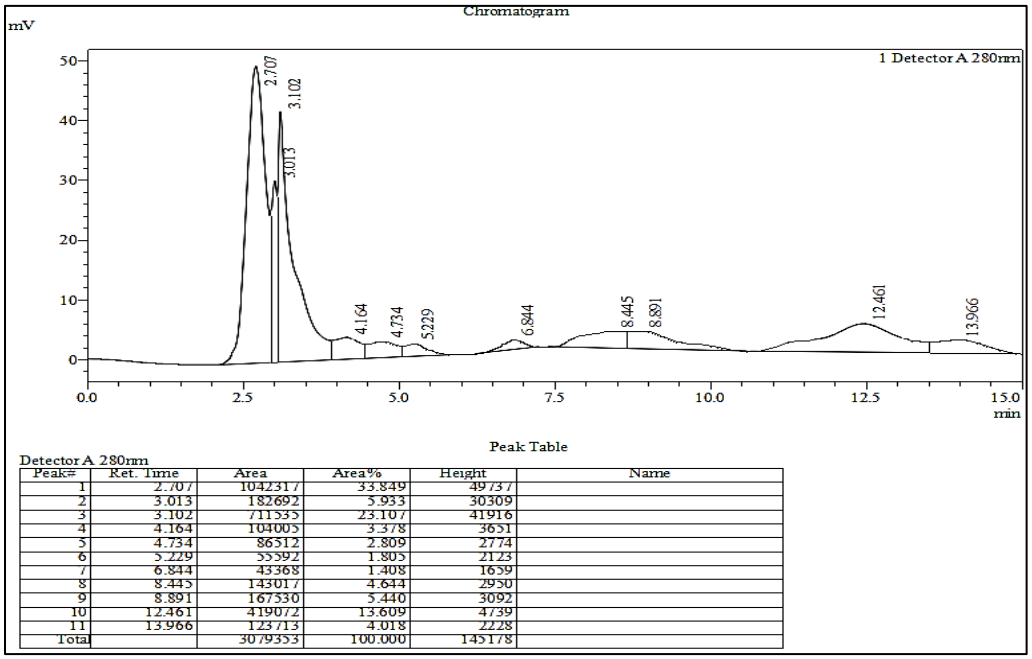
Detector A Channel 1 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.723	656331	20.864	34698	
2	3.112	773085	24.574	42474	
3	4.195	438431	13.937	7426	
4	5.426	77591	2.466	2344	
5	6.592	127797	4.062	1905	
6	7.242	25971	0.826	1087	
7	7.725	3368	0.107	682	
8	7.808	19008	0.604	648	
9	12.324	388723	12.357	4213	
10	12.467	47020	1.495	4140	
11	12.717	35989	1.080	3994	
12	13.973	554539	17.628	6804	
Total		3145838	100.000	110418	

Detector A Channel 2 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.725	654321	20.780	34709	
2	3.112	772039	24.514	42434	
3	4.194	435697	13.837	7431	
4	5.447	80564	2.559	2338	
5	6.590	131433	4.174	1915	
6	7.287	26967	0.856	1089	
7	7.783	20134	0.640	673	
8	12.327	433445	13.765	4217	
9	12.633	14009	0.447	4023	
10	13.966	577119	18.328	6808	
Total		3148798	100.000	105639	

8



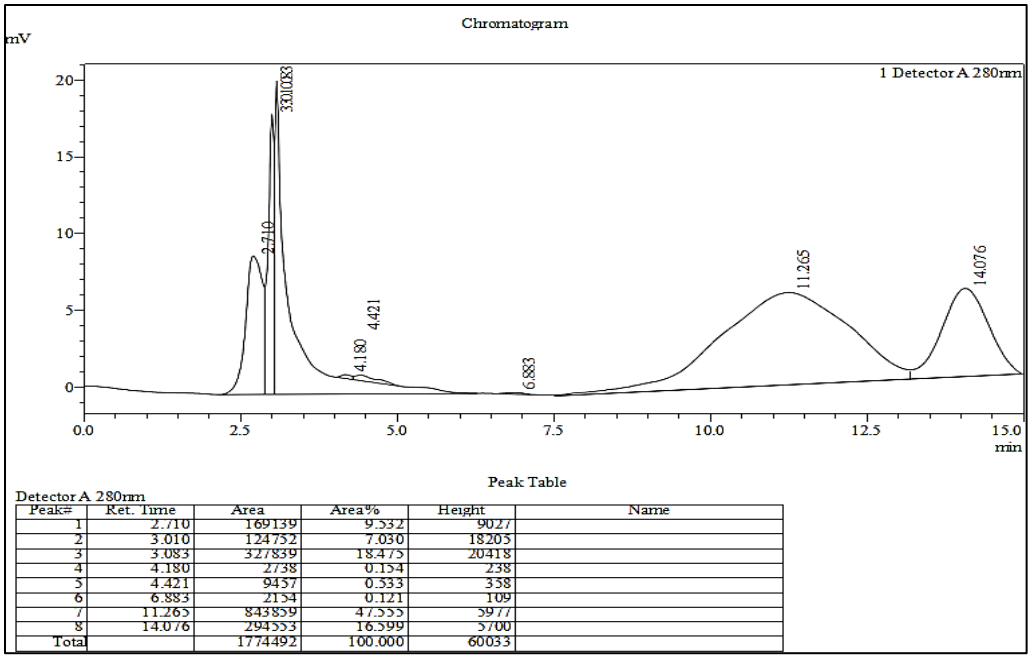
Peak Table

Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.707	1042317	33.849	49737	
2	3.013	182692	5.933	30309	
3	3.102	711535	23.107	41916	
4	4.164	104005	3.378	3651	
5	4.734	86512	2.809	2774	
6	5.229	55392	1.805	2123	
7	6.844	43368	1.408	1659	
8	8.445	143017	4.644	2930	
9	8.891	167530	5.440	3092	
10	12.461	419072	13.609	4739	
11	13.966	123713	4.018	2228	
Total		3079353	100.000	145178	

Figure 8. HPLC Chromatograms of Identified Phenolic and Alkaloid Compounds for the Studied Cultivars:

7. Faleen Turki, 8. Bakira Black.



Peak Table

Detector A 280nm

Peak#	Ret. Time	Area	Area%	Height	Name
1	2.710	169139	9.532	9027	
2	3.010	124752	7.030	18203	
3	3.083	327839	18.475	20418	
4	4.180	2738	0.154	238	
5	4.421	9457	0.533	338	
6	6.883	2134	0.121	109	
7	11.265	843859	47.555	3977	
8	14.076	294553	16.599	5700	
Total		1774492	100.000	60033	

Figure 9. HPLC Chromatogram of Identified Phenolic and Alkaloid Compounds for the Studied Cultivar: 9. Zah-r Bakira.

4. Discussion

The current study of anatomical variations in cell wall shape and crystal distribution are of high taxonomic importance and can be utilized for cultivar delimitation. Stomata were exclusively restricted to the abaxial surface, [18, 19].

The study of the anatomical characteristics of the leaf epidermis, stomatal complexes, and surface indumentum, combined with venation patterns and areole morphology, provides taxonomically significant data for cultivar identification and classification, [20, 21, 22].

The phytochemical analysis revealed that certain phenolic compounds were restricted to specific cultivars, while others showed a broader distribution. This variation in presence and concentration across the studied cultivars is consistent with the findings of [22], who identified phenolic compounds in eight cultivars of apple (Malus domestica L.) and six cultivars of pear (Pyrus communis L.).

Furthermore, the results demonstrated a clear correlation among the studied cultivars through the consistent presence of Apigenin and Gallic acid in all samples. This aligns with several researchers who identified these two compounds as common constituents in grapevines, including [23, 24]. The ubiquitous presence of these compounds represents an evolutionary trait of significant importance, reinforcing their shared taxonomic rank within the species Vitis vinifera L.

On the other hand, the qualitative and quantitative variations in the identified chemical compounds among the cultivars can be attributed to genetic diversity and the influence of environmental conditions on compound biosynthesis, [25]. Consequently, these chemical differences serve as a robust taxonomic

marker and evidence that supports other diagnostic tools, such as morphological, anatomical, and palynological (pollen) studies.

5. Conclusions

The research was beneficial led to examination of Important anatonical and chemical differences between the local grape vine (*Vitis vinifera L.*) Celltivars. Presence Variation in the shape and dimension of antidinal Walls epidermis cells, Stomatal index and the Content and Concentration of chemical Compounds extracted for leaf by using (HPLC)

6. Acknowledgements

We would like to express our gratitude and sincere thanks Department of Horticulture and Landscape Design College of Agriculture and Forestry, University of Mosul, Iraq

7. Conflicts of interest

The authors declare that there is no conflict of interest for this work.

8. Financial support affiliation of the study

The authors confirm that this study was conducted without any external financial support.

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دراسة مقارنة للصفات التشريحية والكيميائية لبعض أصناف العنب المحلية المزروعة في شمال العراق *Vitis vinifera L.*

المستخلص:

تضمن البحث الحالي دراسة مقارنة للصفات التشريحية والكيميائية ل (9) أصناف من العنب Vitis vinifera L. المحلية المزروعة في شمال العراق وهي (سرقولة, شدة بيضاء, بيضاوي, مسكاة سبي, صلوبي, رشميو, فلين تركي, باكيرا اسود, ز هـ ر باكيرا).

شملت الدراسة التشريحية صفات الأوراق من حيث شكل خلايا البشرة العليا والسفلى وابعادها والكساء السطحي لها والثغور والمعقد الثغري Stomata complex والذي كان من النوع الشاذ Anomo cytic type وأن الثغور موجودة على السطح السفلي فقط ونضام التعرق في الورقة من النوع الشبكي الكفي في جميع الأصناف المدروسة. أما في الجانب الكيميائي فشخصت بعض المركبات الفينولية والقلويدية باستخدام تقانة الكروموتوكرافيا السائل عالي الأداء High performance Liquid Chromatography (HPLC) – عن طريق استخلاصها من الأوراق خلال فترة التزهير إذ تم تشخيص (5) مركبات فينوليه وهي (Apigenin, Kaempferol, Quercetin, 2-6-Dimethylphenol, Galicacid) ومركب قلويدي caffeine) فضلا عن تقدير كمية تواجدها في الأصناف المدروسة واتضح ان لهذه المركبات أهمية في عزل الأصناف بعضها عن البعض.