

Determination of Glucose and Fructose Contents of Some Important Red Grape Varieties by HPLC

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Glucose, fructose and sucrose contents of 24 different red grape varieties (*Vitis vinifera*), grown in Turkey, were determined by using high-performance liquid chromatography. Among analyzed samples glucose content of varieties varied from 5.98 % (Alicante) to 12.21 % (Gewürztraminer) and the fructose content was ranged between 5.93 % (Bogakere) and 12.66 % (Md. Jean Mattihas). Sucrose was determined in three different varieties which were Kalecik karasi, Md. Jean Mattihas and Cinsault.

Key Words: Glucose, Fructose, Sucrose, Red grape varieties, HPLC.

INTRODUCTION

Fructose and glucose are considered to be the predominant sugars in most fruits contributing to the flavour of the fruits such as, berries and these sugars are present in approximately equal proportion in some fruits^{1,2}. Nutritionally, fruit juices are an important source of energy in the form of sugars *viz.*, glucose, fructose and sucrose being the most abundant in fruit and fruit products³. During grape berry ripening, other metabolic changes occur, such as the accumulation of sugars in the form of glucose and fructose in the berry (flesh and skin) vacuoles, after translocation of sucrose from the leaves. The accumulation of sugar in the form of glucose and fructose within the vacuole is one of the main features of the ripening process in grape berries and is a major commercial consideration for the grape grower, winemaker and dried fruit producer^{4,5}. Sucrose, which was undetectable in grape cells *in vitro* (result not shown), is also found at only very low levels in flesh and skin of grape berries⁴. Since the amount of sugar in the juice is the major determinant of wine alcohol, actions in the vineyard that will enhance sugar accumulation (such as limiting crop load, optimising light interception, *etc.*) will enhance wine alcohol percentage. During the alcohol fermentation, natural fruit sugar in the grapes is converted into equal parts of alcohol and carbon dioxide by the yeasts. The level of alcohol produced during fermentation depends on the ripeness or sugar content of the grapes⁶. Since the physiological maximum sugar concentration in grapes is around

23-24 °Brix, concentrations greater than this are probably reached through dehydration, which concentrates the sugars within⁷. It is well known that the compositions of fruit juice vary according to varieties or species of fruit, with maturity and as a result of environmental and climatic effects of the growing season⁸.

In this study, 16 red grape varieties were selected, which are grown in Tekirdag Viticulture Research Institute and 8 important red wine grape varieties which are used for production for red wine by Doluca Winery. The aim of this research was to investigate of glucose and fructose content that are major carbohydrates of different grape varieties.

EXPERIMENTAL

In this study, 16 grape varieties (Tekirdag Çekirdeksiz, Adakarasi, Carignan, Cinsault, Kokulu Siyah, Hamburg Misketi, Cabernet Sauvignon, Alfonse Lavallee, Gewürztraminer, Md. Jean Matthias, Maureverde, Bogazkere, Öküzgözü, Papazkarasi, Kalecik Karasi, 2B/56) were selected from red grape variety collection which are grown in Tekirdag Viticulture Research Institute. Hamburg Misketi, Tekirdag Çekirdeksiz, Kokulu siyah, 2B/56 and Alfonse Lavalle are table grape varieties whereas other grape cultivars are red winery grapes. Second group winery grapes were obtained from Doluca. These were Alicante, Kuntra Karasakiz, Denizli Irikara, Gabarnet Franch, Tekirdag Gamay, Cinsault (Senso), Merlot and Syrah. They are important red winery grape varieties which are used for production for red wine by Doluca winery. Cinsault, a common grape variety was compared the same variety, obtained from different place. The grapes were harvested and analyzed at optimum technological maturity.

Determination of glucose, fructose and sucrose: Liquid chromatography (LC) with refractive index (RI) detection is the most common technique used in sugar analysis⁹⁻¹¹. In this study, sugars were determined using an HPLC (Hewlett Packard Series 1050, Hewlett Packard GmbH, Waldbronn, Germany). The high performance liquid chromatograph using a refractive index was used to analyze glucose and fructose of grape varieties. Sample preparation and chromatographic procedure were conducted as described in AOAC¹². Samples were injected directly after filtration.

Chromatographic conditions: Detector: Hewlett-Packard refractive index detector-HP 1047 A RI detector (Hewlett Packard HP 1047, Tokyo, Japan); **Column:** HPLC carbohydrate analysis column-(BIO-RAD) aminex HPX-87 °C carbohydrate column (300 mm × 7.8 mm) (Catalog 125-0095); **Mobile phase:** 100 % ultra distilled water (obtained from Millipore Synergy-185, quality of water is 18.2 MΩ cm); **Flow rate:** 0.6 mL/min; **Column compartment:** 85 °C; **Injection volume:** 20 µL.

Statistical analysis: Statistic analysis were done using MSTAT packaged program and performed two replications and two parallel for randomized complete block factorial test design¹³.

RESULTS AND DISCUSSION

Quantitative data (g/100 mL) of major carbohydrates, along with the ratio glucose/fructose in the different grape varieties studied, are given in Table-1. Also chromatographic profiles of glucose, fructose and sucrose were shown in Fig. 1. In this study, intervarietal comparison of results showed that the glucose variables were significantly different. Among analyzed samples glucose content of grape varieties varied from 5.98 % (Alicante) to 12.21 % Gewürztraminer (Fig. 1). Glucose contents of Kalecik Karasi and than Md.Jean Mattihas were determined also higher than the other grape varieties. Adakarasi and Bogazkere also lower glucose content among the varieties. Sugar accumulation, especially the concentration of high level of fructose, is a very important physiological process that determines the dessert fruit quality¹⁴. The mean glucose value of grape varieties was determined as 8.67 %.

TABLE-1
AMOUNTS OF GLUCOSE, FRUCTOSE AND SUCROSE CONTENTS (%)
PRESENT IN SOME GRAPE VARIETIES GROWN IN TURKEY

Varieties	Glucose (%)	Fructose (%)	Sucrose (%)	Glucose/Fructose
Merlot	10.86 ^d	10.42 ^{bc}	nd	1.04
Gamay	9.59 ⁷	9.82 ^{cd}	nd	0.98
Alicante	5.98 ^t	6.65 ^k	nd	0.90
Tekirdag Çekirdeksiz	9.67 ^h	9.58 ^{ef}	nd	1.01
Adakarasi	6.53 ^r	7.22 ^{jk}	nd	0.90
Kuntra Karasakiz	7.26 ^q	7.43 ³	nd	0.98
Carignan	9.10 ^k	8.99 ^s	nd	1.01
Cinsault	9.47 ^j	8.99 ^s	0.23	1.05
Cinsault (Senso)	8.73 ^m	8.43 ^{gh}	0.18	1.04
Denizli Irikara	9.98 ^l	10.23 ^{bcd}	nd	0.98
Kokulu Siyah	9.44 ^s	10.54 ^b	nd	0.90
Hamburg Misketi	9.13 ^k	9.69 ^{de}	nd	0.94
Gabarnet Franch	9.86 ^e	10.46 ^b	nd	0.94
Cabarnet Sauvignon	10.73 ^c	10.72 ^b	nd	1.00
Alfonse Lavallee	8.25 ⁿ	8.02 ^{hi}	nd	1.03
Gewürztraminer	12.21 ^a	12.24 ^a	nd	0.99
Md.Jean Mattihas	10.93 ^c	12.66 ^a	0.25	0.86
Mourvedre	9.61 ^{hi}	9.80 ^{de}	nd	0.98
Syrah	7.58 ^p	7.27 ^{jk}	nd	1.04
Bogazkere	6.14 ^s	5.93 ^l	nd	1.04
Öküzgözü	7.22 ^q	7.25 ^{jk}	nd	0.99
Papazkarasi	7.69 ^o	8.24 ^h	nd	0.93
Kalecik Karasi	11.92 ^b	10.75 ^b	0.25	1.11
2B/56	8.93 ^l	8.98 ^{fg}	nd	0.99
Ort	8.67	8.81	–	0.98
LSD 0.05	6.541 E-02	0.610	–	–

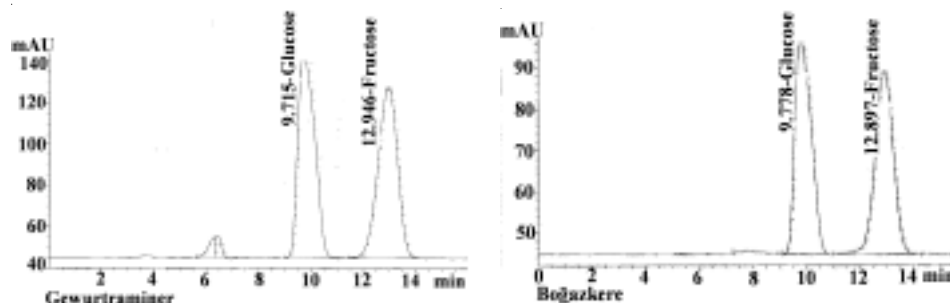


Fig. 1. Chromatographic profiles of glucose, fructose and sucrose of Gewürztraminer and Bogazkere

The fructose content in the analyzed varieties was ranged between 5.93 % (Bogazkere) and 12.66 % (Md.Jean Mattihas). The variety Gewürztraminer was also found to be same group with Md.Jean Mattihas statistically. Kalecik Karasi, Cabernet Sauvignon, Kokulu Siyah and Cabernet Franch varieties were found as second highest group. Bogazkere, Alicante, Adakarasi, Öküzgözü, Kuntra Karasakiz, Shrah also found the low fructose content. The mean fructose content was determined as 8.81 % in different grape varieties.

No additional literature is found regarding the glucose and fructose contents of these varieties, therefore the total sugar content of some varieties were compared. Magarino *et al.*¹⁵ determined the sugar content of Cabernet Sauvignon grapes, between 22.5 and 24.4 g/100 in Spain at the two studied vintages. The glucose and fructose contents of Cabernet Sauvignon obtained as 21.45 % and found to be little lower their findings. The glucose and fructose value of Kalecik karasi was obtained as 22.92 % in this study. Nurgel *et al.*¹⁶ found the sugar content of Kalecik karasi as 220 g/L, which is similar to the present result. Selli *et al.*¹⁷ determined that the reducing sugar of Kalecik karasi 191 g/L in 1998, 195 g/L in 1999 years and which are lower than present results. Rusjan¹⁸ determined the sugar content of cv. Merlot and Cabernet Sauvignon to be 21.80 and 21.20 %, respectively as maximum, among the 15 different location in Goriska and present findings similar with them. In present study, sucrose was measured only in three different varieties and low concentration. Cinsault varieties even which were obtained from different region showed similar sucrose content (Table-1).

The values for glucose and fructose are high with a ratio near one, in grape varieties. The most of the varieties showed that the fructose content higher than glucose content even though the rest of varieties showed that glucose content almost always had higher than the fructose. Intervarietal comparison of glucose/fructose ratio showed that the Kalecik karasi had higher glucose content than the other varieties. On the other hand, Md.Jean Mattihas had the higher fructose content among the varieties. Varandas *et al.*¹⁹ observed the glucose content higher than the fructose content in 5 grape varieties at harvest stage.

Conclusion

This study yielded information about the major sugars which are glucose, fructose and sucrose contents of grape varieties grown in Turkey. The results showed that, there were significant differences in the glucose and fructose content in selected different varieties. Sucrose was found only three varieties and lowest level in all experimental varieties among the detected sugars. The results reflect that there must be genetic variation among the grape varieties according to their individual sugars.

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