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Élelmiszertudományi Kar

THE EFFECT OF THE VINE LOAD ON THE COMPOSITION OF THE BERRIES, OF THE MUSTS AND OF THE WINES

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1. Introduction

In oenology as a market- and consumer-oriented production – with regard to the legal requirements and food safety standards – the quality of the wine for consumption should reflect its quality category. The winemaker necessarily needs to know the properties of the harvested yield, which is used as raw material in the wine-making process. The composition, the physical and health status and quality should be well-known. Based on this knowledge the expert may consider what technology should be practised to create the end-product (wine) in conformity with the legal requirements and consumer expectations.

The final product of the wine growing techniques is the grape, which is also the starting material of wine technology as well. In order to produce grapes for wine production the vineyard works have therefore the function to produce raw material with an optimal composition and physical, biological properties. However, the object of the oenological technology is to transfer the favourable components of the grapes into the wine; however, the disadvantageous components should be not extracted.

During my works the impact of wine growing techniques (pruning methods resulting in various bud load rates, thinning out at veraison) on the composition of the berry, the must and the wine, and the extractability of some components from the berry skin into the wine were investigated. The studies were carried out on the 'Kékfrankos', a wide-spread and rightly popular Hungarian red wine variety.

2. Object of the studies

Basic objective of this work was the qualitative and quantitative analysis of the components developed during the maturation in the grape, the examination of the qualitative and quantitative transformation of these components during the fermentation, as well as the determination of the transferable amount of the compounds from the berries into the wine.

This work mainly focuses on the impact of wine growing technology on the wine quality: The composition of the grape material, the must and the wine was analysed.

Beside the basic object the question is, to what extent the compounds are extractable from the technologically ripe grapes into the wine. The *extraction coefficient* (EK) characterizes the extractability of some phenolic compounds during fermentation.

3. Matherial and methods

Berry skin, must and wine samples

The grape and wine samples were collected on the Kékfrankos-plantation of the Experimental Farm of the Corvinus University of Budapest Soós István Secondary School for Viticulture. The vine load experimental concept was set by the Faculty of Viticulture, CUB. The vineyard works were carried out by the colleagues and students of the Experimental Farm and of the Faculty of Viticulture. I was related to the workflow at the time of harvest.

The berry skin of the technologically ripe grapes, the musts immediately after pressing, and the microvinificated, once racked new wines were investigated in three vintages (2005, 2006, 2007).

The plantation size did not allow analysing multiple samples, so the parallel measurements were provided in the three vintages. ***In order to evaluate the data by mathematical-statistical methods, the multiple analyses were carried out in the three parallel vintages.*** This way it was also possible to investigate the relationship between vine load and wine quality excluding the influence of the vintage characteristics.

The plantation was divided into three sectors, in which three different pruning methods were used resulting in different bud loads. In all three sectors one-third of the vine stocks were selected and marked, which were thinned out (cluster selection) at the beginning of veraison. As a result, on each shoot one bunch was left.

The three pruning methods and the cultivation without or with thinning out resulted six different vine loads (*Table 1*).

Table 1 Sample markings

marking	**pruning method**	**cluster selection**
KT	spurs	no
KTF	spurs	yes
Ü	semi long canes	no
ÜF	semi long canes	yes
NT	canes	no
NTF	canes	yes

Berry samples of the six vine stock sectors were collected during harvest. The separated berry skin samples were extracted with a 6 : 4 ratio of methanol : water solvent containing 1 V/V% cc. hydrochloric acid. The tests were carried out in the berry skin extracts, in the musts after pressing, and in the once racked new wines.

The sugar content were analysed with refractometer ([g/100 g fluid]), the alcohol content by the Hungarian standard MSZ 9458:1972, the sugar-free extract by the Hungarian standard MSZ 9463:1985, the glycerol- and malic acid content with Boehringer-Mannheim enzyme kit, the titratable acid content by the Hungarian standard MSZ 9472:1986, the tartaric acid content by the Hungarian standard MSZ 9489:1978 by the spectrophotometric method, the pH-value by the Hungarian standard MSZ 14849:1979 by the potentiometric method.

In order to measure the total polyphenolic content of the prepared samples, SINGLETON and ROSSI'S (1965) method was applied; the measurement of the anthocyanin concentration was carried out according to RIBEREAU-GAYON and STONESTREET (1965). The quantity of leucoanthocyanins and catechin was determined as described by FLANZY and co-workers (1969) and REBELEIN (1965), respectively. The colour intensity and hue was measured by the Hungarian standard MSZ 14849:1979.

The qualitative and quantitative determination of the resveratrol components and the anthocyanin monomers was carried out in the research laboratory of the Department of Oenology BCE by high-performance liquid chromatography.

The analysis of the resveratrol compounds was carried out according to KÁLLAY and TÖRÖK (1997). The eluent for the isocratic HPLC-analysis consisted of 5 : 5 : 90 = acetonitrile : methanol : water. Circumstances and chromatograph settings are as following:

HPLC-apparatus	HP Series 1050
column	LiChrospher® 100, CN 5 µm (Merck, Germany)
detector	HP Series 1050
flow	2 mL/min
temperature	30 °C
wavelength	306 nm

The qualitative and quantitative determination of the anthocyanin-monomers was carried out by the method published by KÁLLAY and TUSNÁDY (2001). The gradient elution time pattern is described in *Table 2*.

Table 2 Gradient elution

time [min]	**solvent „A” [%]**	**solvent „B” [%]**	**solvent „C” [%]**
0	0	8	92
20	0	20	80
25	0	30	70
30	0	40	60
35	0	80	20
40	100	0	0

Circumstances and chromatograph settings are as following:

HPLC-apparatus	HP Series 1050
column	ODS Hypersil C18, 100 × 4,6 mm, 5 µm
detector	HP Series 1050
flow	0,5 mL/min
temperature	25 °C
wavelength	520 nm
eluents	solvent „A”: 50 mM ammonium-phosphate; pH = 2,6
	solvent „B”: 20% solvent „A” + 80% acetonitrile
	solvent „C”: 0,2 M H_3PO_4; pH = 1,5

Extraction coefficient (EK) values of total polyphenolics, anthocyanins, leucoanthocyanins and katechins were calculated in order to characterise the extractability of these compounds. During the course of the punching red wine-making technology, approximately 25% of the rape of the fermenting liquid is required to extract colorants and other phenolic components from the pomace. Thus, 3 parts of “liquid” (wine or fermenting must) are required to extract 1 part of solid phased “material” (pomace). During the course of pressing the solid material is eliminated, so theoretically, in the liquid phase the concentration of extracted substances can be no more than one-third of the value of concentration measured in the solid phase:

$$C'_{wine}\ [\text{mg/L}] = 1/3 \cdot C_{berry\ skin}\ [\text{mg/1000 g}],$$

if C'_{wine} is theoretically available maximum concentration in wine;

$C_{berry\ skin}$ is the concentration in the berry skin.

The *extraction coefficient (EK%)* is the percent rate of the theoretically available maximum concentration in wine and the measured concentration in the berry skin:

$$\text{EK}\ [\%] = (C_{wine} : C'_{wine}) \cdot 100,$$

if C_{wine} is the concentration in the wine;

C'_{wine} is theoretically available maximum concentration in wine.

Components with two or three parallel measurements were investigated by two-factor analysis of variances. The statistical factors for the calculations were bud load and cluster selection.

The relationship between the concentration of some compounds in the berry skin extracts and in the wines were analysed by the Pearson correlation analysis.

4. Results and discussion

Berry skin analysis

5-15 g/kg **total polyphenolics** concentration was detected in the berry skin samples cultivated at various vine loads. The average concentration of the three parallel samples show that cluster selection reduced the polyphenol content in the berry skin of both the spur- and semi long cane-pruned vines, but thinning out caused an increase in the berry skin of cane-pruned vines. It seems that the results are strongly influenced by vintage characteristics. No correlation between the pruning method and the polyphenol content of the berry skin was observed.

No relationship between the bud load and the **anthocyanin** concentration of the berry skin was recognised. However, the comparison of pruning methods show that a lower anthocyanin concentration can be achieved with cane-pruning method, as either with spurs or with semi long canes in all three vintages.

As the effect of cluster selection at both spur- and cane-pruning the average **leucoanthocyanin** content increased. In the case of semi long canes the concentration in the berry skin decreased. No significant correlation was discovered between the vine load and the leucoanthocyanin content of the berry skin. There are significant differences between vintages, but the leucoanthocyanin content of grape samples proved to be unaffected by vine load in this study.

The **catechin** content increasing effect of cluster selection was observed at all three pruning methods. The spur-pruning method resulted in slightly higher catechin content in the berry skin samples, than the semi long cane- or the cane-pruning technique. The catechin content in the berry skin increased as a result of thinning out, but the rate of this was not statistically significant. There was no clear trend between bud load and catechin content.

Contrary to expectations, *trans*-**resveratrol** was detected in the berry skin extracts. This can be explained by the extraction conditions as the splitting of the glycosidic bond can take place by acid hydrolysis. However, repeated measurements after acid hydrolysis also led to similar results, so the appearance of *trans*-resveratrol in berry skin extracts are likely caused by microbial β-glucosidase activity. While examining the average values it can be concluded that cluster selection had a positive effect on the *trans*-resveratrol content of the berry skin in the case of all three pruning methods, however, this was not proven by the statistical analysis. No effect of the vine load on the concentration of resveratrols was observed, however, the difference between the three vintages is clear.

Among **monomer anthocyanins** the malvidin-3-monoglucoside proved to be the predominant colour component of the berry skin. The total amount of monomers was much higher in the vintage 2006 than in 2007. The effect of cluster selection is not clear: The concentration significantly decreases in some samples while in others rises compared to the samples which were not thinned out. The two-year average of the samples show, that p-coumarates were present in greater quantities among anthocyanin-ester derivatives. The glucose-acetates were detected in lower concentrations in all six berry skin samples. The analysis of the two vintages does not demonstrate a correlation between vine load and the concentration of monomer anthocyanins in the berry skin; however, it seems that higher bud load reduces the concentration of monomer anthocyanins including acylated anthocyanin derivatives in the berry skin. This trend was found in the case of malvidin-3-monoglucoside and of its acylated derivative, the malvidin-3-glucoside-(p-coumarate). However, the amount of the other acylated malvidin-glucoside derivative malvidin-3-acetate was higher in all samples both with higher bud load and with cluster selection.

Analysis of the musts

The **sugar** content of the musts may not be increased due to thinning out. In 2005, cluster selection caused relatively significant increase (at least 0.5 g/100 g fluid) in the case of all three pruning methods. In 2006, the trend is observed only in the case of cane-pruning method, the spur and cane pruned samples did not show either positive or negative change according to the cluster selection. In the vintage 2007 the cluster selection increased the sugar content of the cane-pruned samples by 0.2 g/100 g fluid, however, some reduction in sugar content can be observed in the case of spur-pruned vines (a decrease of 0.8 g/100 g fluid). The three-year average does not show correlation between the vine load and the sugar content of the must.

Acidity was similar in the 2005 and 2006 vintages, musts in 2007 had about 1.5 to 2 g/L less acidity. In 2005 the cluster selection resulted in a decrease of the acid content with all pruning methods. In the other two vintages the cluster selected samples had a higher acid content at harvest. A comparison of the three pruning methods does not show correlation between bud load and acidity. There is no difference in the three-year average acid content of the vine loads. The three-year average of the six samples was around 9.5 g/L.

The **pH-value** of musts was between 2.95 and 3.11, corresponding to literature data. Neither bud load, nor cluster selection had an effect on the pH-value of the musts.

The composition of the wines

Neither bud load nor thinning out can be clearly associated with the development of the **alcohol** content of wines: The cluster selection resulted in higher alcohol content with both spur and cane pruning methods, and lower alcohol content with the semi long cane pruning.

The **sugar-free extract** content of the studied wines tended to be higher in samples with cluster selection. The trend can be observed that higher bud load decreases extract content. Cluster selection has a stronger improving effect in samples with higher bud load.

Titratable acid content decreased 1-3 g/L during fermentation. The highest decrease is observed in the 2006 vintage samples, the smallest loss of acidity in 2007. The acidity ranged from 6.6 to 8.7 g/L what can be described as usual in new wines. In several cases, a higher acid content was detected in samples with cluster selection.

The vine load did not affect the **pH-value** of the samples; no correlation can be discovered in the bud load and cluster selection and the acidity of the wine. The pH-value seems to be characteristic of the vintage, because the wines produced with different vine load had a similar pH-value in each vintage, but differences between vintages can be observed.

The **total polyphenolics** content in wines varied relatively wide between 640 and 1757 mg/L. The concentration was nearly the same in the vintages 2005 and 2007; however, in the samples of 2006 approx. one and a half times as many polyphenols have been identified as in the other two years. The average values of the three vintages show, that cluster selection increases the concentration in the case of each pruning methods. There is a downward trend in the polyphenolics concentration while increasing vine load.

The wines had relatively low concentrations of **anthocyanins**. The literature data define slightly higher (at least 200 mg/L) anthocyanin concentration in new Kékfrankos wines than recent measurements. The obtained concentration values can be explained by the circumstances of microvinification technology. The three-year average anthocyanin concentration was between 120-150 mg/L; the higher bud load resulted in higher pigment content (KT, Ü, NT samples). The cluster selection had no influence on the concentration: The cluster selection had an increasing effect on the anthocyanin concentration in spur pruned wines, and a decreasing effect in semi long cane and cane pruned wines.

The samples had different **leucoanthocyanin** concentration in the three vintages. Relatively high values were detected in the 2006 vintage; The 2005 and 2007 wines contain leucoanthocyanin about the same concentration, although standard deviation is quite high. The average values decreased while increasing bud load (KT, Ü and NT samples). The concentration slightly increased as an effect of the cluster selection.

The **catechin** content of the wine samples followed the trend of the berry skin extracts: Independent from cluster selection, the spur pruned wines achieved almost twice as much catechin concentration than semi long cane pruned wines, and significantly more than cane pruned wines.

The average **colour intensity** values of the six wine samples range between 3.8 and 5.4. The colour intensity decreases with increasing bud load; the colour intensity of the cluster selected wine was slightly better in the case of spur and cane pruned vines, but the cluster selection did not cause any particular change in the case of semi long cane pruned vines. The **colour hue** of the wines refers to healthy wines with no susceptibility to browning.

Piceids was not detected in all wine samples, as expected, since the glucoside form transforms into resveratrol due the yeast enzyme activity during fermentation. The *trans*- and *cis*-piceid content of the wines was considerably lower compared to the berry skin extracts, the maximum concentration of the components was 0.5 g/L in wines. Similar to the berry skin extracts, the natural *trans*-conformation of the molecules can be detected in the wines, too.

Trans-**resveratrol** – similar to the glycoside form – was present in higher concentrations in the wine samples, than the *cis*-molecule. With one exception (NT sample in 2005) at least trace amounts of *trans*-resveratrol was detected in each wine sample. In the 2006 vintage relatively high *trans*-resveratrol concentration values were measured.

The average amount of **anthocyanin monomers** was between 350-500 mg/L concentration in the wines. This concentration is practically ten times lower, than the concentration in the berry skins. The positive effect of the cluster selection can be observed in the case of spur and cane pruned vines, however, in the wines with semi long cane pruning the cluster selection caused lower concentration of anthocyanin monomers. There is no clear trend depending on the bud load. Similar to the results of berry skin extracts, p-coumarate derivatives were detected in higher concentration than glucose-acetate esters of the monomers. The quantity of the acetate derivates was ten times lower present in the new wines, than in the berry skin. The amount of acylated derivatives had a significant proportion within the total quantity of anthocyanin-monomers. While this proportion meant a few percent in the berry skin, the acylated monomers were present in a rate of 15-35% of the total anthocyanin monomer content in the wines. The malvidin-glucoside and its derivatives have the highest amount of anthocyanin-monomers in the wines as well as in the berry skin extracts. There is no difference between the three years averages of the influence of the different vine loads; neither the effect of bud load, nor of cluster selection can be detected. The trends observed in the berry skin are not present in the wines. Based on recent results neither the total amount of anthocyanin monomers, nor the concentration of malvidin-glucoside and its derivatives is associated with the investigated vineyard works. However, the amount of acylated anthocyanin monomers – similar to the results of the berry skin extracts – was higher in the samples produced with higher bud load; without cluster selection a lower concentration was detected than in the samples with cluster selection. In contrast to the berry skin investigations, p-coumarate derivatives were present in a higher amount than the glucose-acetate esters in wine samples, but the differences between the vintages are crucial in the case of wines, too.

The extractability of some compounds

The extractability was calculated by the method mentioned above in the case of total polyphenolics, anthocyanins, leucoanthocyanins and catechins based upon the analytical results of berry skin extracts and wines.

The data show that approx. 38-40% of the total amount of **polyphenols** can be transferred from the berry skin to the wine by the punching wine-making technology used in recent experiments. The best results were achieved in the case of ÜF load (42.9%), the lowest extraction average was found in the NTF samples (34.4%). The positive effect of cluster selection was observed in the case of spur and semi long cane pruning methods (approx. 5% improvement), however, with the cane pruning method a reduction of the extraction coefficient in the same proportion (5%) was observed.

About 15% of the **anthocyanin** content could be extracted from the berry skin into the experimental wines. We cannot site any significant difference between the samples produced without the application of cluster selection (KT, Ü, NT), however, the values of the extraction coefficient increase as the number of buds increase. As with the extractability of the total polyphenolic content, an increase in the case of spur and semi long cane pruning in the anthocyanin content can also be detected, the extraction coefficient – although the 3-4% change is not significant – rose, while in the case of vine-stocks pruned to canes it decreased significantly, as a result of cluster selection.

Leucoanthocyanins could be extracted to the extent of about 25%. The best extraction average was recorded among the cluster-selected crops with semi long cane pruning (30.6%), while the lowest extraction was generated by NTF treatment (22.5%). Cluster selection does not have any striking impact in the case of spur pruning (decreased at 0.5%), whereas when dealing with the semi-long cane-based cultivation, cluster selection increased the extraction rate by 5% and with cane pruning, it decreased to a similar extent, by 5%. However, none of these differences are significant. On the basis of the results, the extraction of leucoanthocyanins does not seem to depend on the manner of vine cultivation applied; however, differences found among the vintages are quite striking.

The extractability of **catechins** was about 45%. The best extraction average was produced during the NT cultivation (52.9%), whereas the worst data were produced by applying NTF cultivation (34.6%). On the one hand, the extraction coefficients of the KT and Ü methods of cultivation improved by 1-2% due to cluster selection. On the other hand, during cane-based cultivation, the 8% decrease in the EC% averages, as a result of cluster selection is striking.

Correlation analysis of the results

In the correlation analysis of the data the vine load and the vintage were ignored: the correlation analysis of a sample with 18 elements (6 in each vintage) was carried out.

The conclusion of the correlation analysis is that the lower concentration of the phenolic compounds in the berry skin, the higher their extractability during the punching vinification method.

Significant correlation is observed between the total polyphenolics, anthocyanin, leucoanthocyanin and catechin concentration in the berry skin extracts and in the wines. The high concentrations in the berry skin do not necessarily mean that this amount is displayed in the wines, since this also depends on the extractability. Recent study discovers a significant positive correlation between the phenolic compounds in the berry skin and in the wine; however, better extractability results (higher numerical value of the extraction coefficient) do not automatically mean higher concentrations in wines.

Based upon mathematical statistics many correlations between the investigated parameters can be discovered, which are supported by technological aspects. However, we cannot say with certainty that all the proven mathematical relationships truly reflect the processes during winemaking, but further investigations can prove whether these are correct or incorrect.

5. Scientific findings

1. In recent experiments, the Kékfrankos grape and wine composition produced with different pruning and cluster selection methods was investigated. The technologically important basic composition and characteristic have been examined: sugar content, acidity and pH of the musts, and alcohol, extract, acidity and pH of the wines. *Based on recent investigations, no significant relationship can be detected between the applied vine load and the basic analysis values of musts and wines (sugar, acidity, alcohol and extract content), although in some cases the quality improving effect of cluster selection can be observed.*

2. Another group of the examined components were the various phenolic compounds. Anthocyanin, leucoanthocyanin, catechin, resveratrol and total polyphenolics concentration in berry skin and wine samples were measured. *Neither pruning method, nor cluster selection influenced the amount of phenolic components; however, these compounds were detected in different concentrations in various vintages.*

3. The anthocyanin profile of the berry skins and of wines produced by various vine load methods were examined. Eleven different anthocyanin monomers were detected in both the berry skin extracts and the wines. Malvidin-3-monoglucoside and its acylated derivatives were present in the highest concentration. The amount of anthocyanin monomers was higher in the samples with higher vine loads, but in the case of the wines no effect of the vine load was observed. *The qualitative and quantitative composition of the anthocyanin monomers was not influenced by the vine load, but differences of the concentration values in the three vintages were found.*

4. Only a small percentage of the amount of the berry skin components discussed in the *2. paragraph* was present in the wines, and the trend of the berry skin samples and the wines was not always similar. Based on the theory of wine-making technology and of the chemical and physical transformation of the components during fermentation, the maximum amount of theoretically extractable material was defined, and the extraction coefficient of some phenolic components was calculated. This index is independent from the absolute value of the amount of material measured in the berry skin and in the wine, as it informs about the transport of the components during fermentation on skin. *The extraction coefficient can be used to characterize the extractability of the components in the berry skin and the phenolic ripeness of the grapes.*

5. The extraction coefficient of total polyphenolics, anthocyanins, leucoanthocyanin and catechin was determined in the case of the various vine load methods, so the highest theoretically extractable concentration was compared to the actually detected quantity in the wines. *The*

extraction coefficient of total polyphenolics, anthocyanins, leucoanthocyanin and catechin of the investigated samples showed no correlation with the vine load.

6. The relationships between the concentration of components in the berry skin and wine, and the extractability were examined by the correlation analysis of the measurement results. *Based on the data significant correlation was discovered between the concentration of phenolic compounds in the berry skin and in the wine, between the concentration in the berry skin and their extractability, however no correlation was found between the extractability and the concentration of phenolic compounds in the wines.*

6. Conclusions

During the studies a comprehensive analysis of the berry skin, must and wines of Kékfrankos grown with different vine load technologies was carried out. Recent work confirms that the grape production for quality wines cannot ignore the vintage characteristics.

The results presented in this paper demonstrate that – beyond the yield limitations – the pruning and the cluster selection have an influence on grape and wine quality and composition, but it is questionable whether the effect of all vintages, each region and each grape variety is positive and general. However, the fact is that the vineyard works are critical to the development and condition of the vine, to the yield and to ensure sustainability. A professional canopy management is of interest of plant protection, and may also contribute the reduction of environmental pollution.

Measurement results suggest that different vine load can provide the continuity in wine quality in different vintages, which is the requirement of consumer-oriented wine production towards wine growing technologies.

7. Scientific publications

Journals with IF:

Leskó, A., Kállay, M. (2011). Variations in the extractability of certain phenolic components in *Vitis vinifera* cv. 'Blaufraenkisch' clusters and wines as a function of vine load. Acta alimentaria 40(Suppl):91–100.

Hungarian journals without IF:

Kállay M., Leskó A. (2007). A terhelés hatása az élettanilag fontos vegyületekre a 2006-os évjáratban. Borászati Füzetek, 17(5):1–5.

Nyitrainé Sárdy D., Leskó A., Kállay M. (2011). Rezisztens szőlőfajták színanyagösszetételének vizsgálata. Borászati füzetek, 22(1):4–8.

Hungarian conferences, full paper:

Kállay M., Leskó A. (2007). A rügyterhelés hatása a borminőségre, különös tekintettel az élettanilag fontos vegyületekre. Lippay–Ormos–Vas Tudományos Ülésszak – Élelmiszertudományi Kar, Budapest, Hungary, 2007. november 7–8., pp12–13.

Pásti Gy., Leskó A. (2008). Kékfrankos borok borászati értékelése. Szent György nap - a szőlő és a bor ünnepe. Szakmai tanácskozás. Kőszeg, Hungary, 2008. április 24., p5.

Kállay M., Leskó A. (2009). A liofilezés mint mintaelőkészítési lehetőség a szőlő illetve a bor néhány polifenolvegyületének analíziséhez. Lippay–Ormos–Vas Tudományos Ülésszak – Élelmiszertudományi Kar, Budapest, Hungary, 2009. október 28–30., pp6–7.

Balga I., Leskó A., Kállay M. (2009). Polifenol vegyületek eloszlása a szőlőfürtben. Lippay–Ormos–Vas Tudományos Ülésszak – Kertészettudományi Kar, Budapest, Hungary, 2009. október 28–30., pp256–257.

International conferences, full paper:

Leskó, A., Kállay, M. (2010). Effect of Vine Pruning and Cluster Thinning on Anthocyanin Composition in Vitis vinifera cv. Blaufraenkisch Grapes and Wines. 7th International Conference of PhD Students, Miskolc, Hungary, 8–12 August 2010., pp29–34.

Other prizes awarded to students:

Leskó A. (2006) Rügy- és fürtterhelés hatása a szőlő és a bor összetételére a Kékfrankos fajtánál. XVI. Magyar Élelmezésipari Tudományos Egyesület Élelmiszertudományi Konferencia, Mosonmagyaróvár, Hungary, p50. “Special Prize”