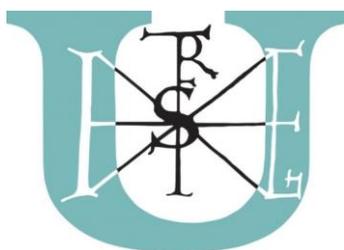


Thesis

**KANYÓNÉ RÁCZ KINGA
GÖDÖLLŐ
2016**



**SZENT ISTVÁN EGYETEM
ÉLELMISZERTUDOMÁNYI KAR**

**EXAMINATION OF THE EFFECTS OF YIELD
REGULATION OF GRAPES ON THE QUALITY OF
WINE**

KANYÓNÉ RÁCZ KINGA

**Gödöllő
2016**

A doktori iskola

Megnevezés: Élelmiszertudományi Doktori Iskola

Tudományága: Élelmiszertudományok

Vezetője: **Vatai Gyula, DSc**
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A doktori iskola- és a témavezető jóváhagyó aláírása:


Az iskolavezető jóváhagyása




A témavezető jóváhagyás



1. Precedings, objectives

In my university thesis changes in polyphenol compounds of grape during veraison were examined by me.

In my PhD work I tried to find the answer whether „yield regulation” popular with winemakers nowadays is merely a marketing tool enhancing prestige or a real technology to improve quality.

In order to solve the above mentioned task, yield restriction was carried out on four different grape varieties over three vintages grown in Eger wine district. Consequently, I came to analyse the sensory attributes as well as the chemical compounds of the experimental wines made by using the same microvinification. The process resulting in three different loads of the vine stocks made us expect a deviation in quality, since cluster thinning was implemented at the beginning of veraison (color change). The vintages of experimental series carried on Hárslevelű, Chardonnay, Kékfrankos and Merlot were in 2011, 2012, 2013.

My experiments were carried out in the vineyards of Egri Korona Winehouse in Eger Wine Region on Kékfrankos, Merlot, Chardonnay and Hárslevelű varieties. The main motivation of my research was to answer the question what kind of content- and sensual changes occur in wines in three different loads of one grape variety. However, to be able to examine the effects of vine load unambiguously, all other factors causing differences such as vintage, viticulture- and oenological technologies had to be eliminated.

The aim of my research and also my thesis was to examine the following:

1. Is there correlation between quantity or any basic analytical parameter and the various levels of yield regulation?
2. Is there connection between decreasing vine load and the amount of certain polyphenol compounds?
3. Comparison of total polyphenol content, colour intensity and colour tone of wines and the different levels of vine loads..
4. How many different anthocyanin-manomers can be measured in red wines and does the quantity of these show any tendency related to yield?
5. In what extent does the fine-composition of wines depend on vintage and grape variety?

6. Is there any connection between any examined component of the wines and the quality order of the sensory evaluation?
7. Parallel examination of titrable acid- and pH values of wines made from yield regulated grapes?
8. Does the quantity of mycotoxins (Ochratoxin A and Aflatoxin B1) added to must samples decrease below health limit during the aging process?

2. Material and method

The grape growing experiment was started in 2011. 4x4 experimental rows were chosen from every variety with 40 vines in each row in the plantation. When pruning, in the control rows all the buds were kept on 2 branches, on the other rows when veraison started – at the end of July, beginning of August – various degree (20%, 40%, 60%) of cluster thinning was done. This way, control and treated blocks were arranged random on each variety four times repeated. All together 16 rows were tested per variety. Having known and analysed the results of year 2011 we decided that no 60% restriction was needed in the future. Thus in 2012 and 2013 besides the control rows only 20% and 40% cluster thinning was done.

After having harvested the fully ripen grapes the amount of the fruit and and the prix was checked at the various load levels. The new wines made with identical winemaking technology and racked twice were undertaken analitical examinations when alcohol content, pH, titrableacid- and sugarfree extract were measured. All poliphenol-, anthocyanin-, catechin-, leucoanthocyanin content, colour intensity- and tone were determined by spectrophotometer. Quality- and quantity determination of rezveratrols and anthocyanin-monomers were done by high power liquid cromatography (HPLC) procedure.

The wines were organoleptically judged by an 8-member jury.

The measurement results were evaluated by mathematical stastistical method.

The possibility was given for me to match my pressed and filtered musts made with yield regulation, blue grape musts fermented on the skin, the being-transformed must-wine system and the new wines with the mycotoxin monitoring research ongoing at Egri Korona Winehouse

3. New scientific results (Thesis)

1. In case of all the examined grape varieties (Hárslevelű, Chardonnay, Kékfrankos, Merlot) it can be stated that the vines regulated to 80% yield 85-90% grape, while the ones reduced to 60% yield 70-75% fruit, so it means that the plant- by the berries growing more intensively- does correction, compensation of the loss of yield caused by cluster thinning.

2. Examining analytical features essential in oenocological technology it can be stated that sugar content at harvest and sugar-free extract content resulting in full-bodiedness of wines are correlated (correlation coefficient between 0,89 and 0,92) to the yield in each year.

3. Based on the results of big analytic examinations (HPLC, spectrophotometer) of experimental samples it is obvious that total polyphenol content increases in all the wines, In the case of Hárslevelű variety in grapes reduced to 80% total polyphenol grew by 5%, while in grapes reduced to 60% total polyphenol resulted in 11% growth. In Chardonnay wines 7% and 5% total polyphenol-content growth was detected. In Kékfrankos 3% and 20%, while in Merlot wines 9% and 15% total polyphenol-content growth happened.

4. While total polyphenol content of white wines (Hárslevelű and Chardonnay) is between 320–450 mg/l, average total polyphenol content of red wines (Kékfrankos and Merlot) is 2070 mg/l, which is 5,5 times bigger than the average values of white wines.

5. Although good effect of yield regulation on polyphenol compounds can be checked, no unambiguous effect mechanism of yield regulation can be detected in my experiments. In the samples coming from different levels of yield regulation polyphenol compounds do not show linearity, that is in case of certain components higher concentration can be achieved with 60%-, while at other ones with 80% vine load. In 2011 vintage no major differences can be experienced when matching the wine composition values at 60% and 40% load levels.

6. Having examined anthocyanin composition of wines coming from vineyards of different vine load eleven different anthocyanin monomers were revealed from which malvidin-3-monoglucosid was present in the biggest quantity in both red wines. In wines from vines producing different yield due to cluster elimination quality change in anthocyanin-monomers cannot be detected.

However, quantity of acilised anthocyanin derivatives and acetate/cumarate proportion shows growing tendency in both red wines, that is reversely related to the yield.

7. The rank set up by the sensory features of the wines mostly (75%, that is in 24 out of 36 samples) overlap the sequence based on total polyphenol content measured, that is organoleptic evaluation of wines is closely related to total polyphenol content.

8. Summarising the pH and titrable acid content values of wines made from yield regulated Kékfrankos and Merlot grapes it can be stated that adding H₃O⁺ concentration giving pH and concentrations of titrable acid amounts expressed in 0,1 µmol/l and logarythmic values of these the total is always contant. Bigger amount of minerals getting in the wine by yield regulation shows increase of pH in wine, that is it results in the increase of K- and Ca-salt concentration of tartaric acid. It is made clear for winemakers by pushing the balance to tartar deposit.

9. These experiments show that the amount of Ochratoxin A és Aflatoxin B1 added to the must samples gradually decreases during fermentation and aging of the wine. The amount of micotoxins in the four Hungarian wines examined were always below detection level. Taking climatic warming into consideration, that is shifting towards Mediterranean and being aware of the problems existing at our climate micotoxin measurements were done by me on wines made from yield regulated grapes as prevention.

4. Conclusions and recommendations

As for vintage brix values 2011, 2012 and 2013 harvests of Hárslevelű, Chardonnay, Kékfrankos and Merlot wines it can be stated that they change in inverse proportion when decreasing vine load, that is sugar content of the grape increases. My values support literature findings on sugar content increase resulted from cluster thinning (BAUER, 2002).

Having performed classical analytical examinations of wines big changes in certain components are related to yield regulation: taking sugar-free extract content of new wines it increased in the wines due to cluster thinning except Chardonnay and Merlot samples of 2012, which support the results published by MORANDO et al. (1991).

My experiments have proven that wine made from grape grown in leptosol formed on volcanic rock has high mineral content depending on the variety, terroir (soil, microclimate) and rainfall before the harvest. The mineral content of the wine taken from the soil is represented mostly in extract content, dry material content. Since wine is a real buffer system (buffer system of multi-component acids-salts), it means representation of titrable acid and pH in the same measure and their comparison adequately helps with assessing the quality of the wine. More mineral getting in the wine through yield regulation shows pH increase of the wine that is it results in the increase of K- and Ca-salt concentration of tartaric acid, that is pushing the balance to tartar deposit. We have managed to find numeric connection between titrable acid content and pH values, the growth of which values proves that metal-ion content (Ca, K) grows due to yield regulation.

From among polyphenol components of big importance anthocyanins, leucoanthocyanins and catechins were examined. In 2011 and 2013 leucoanthocyanin content of Merlot wines changed in inverse proportion, that is grew when decreasing load. Even at this variety year 2012 is an exception, where the tendency is opposite, that is decrease in load resulted in decrease of concentration. Catechin content of Kékfrankos changed in line with the decrease of vine load, that is decreased in 2011 and 2012. It can be stated both in the case of Kékfrankos and Merlot wines that vintage has greater effect than yield regulation since the results in certain vintages are quite similar independently of load level.

While maldivin-3-monoglucosid values in anthocyanin-monomer composition of Kékfrankos wines - with one exception - show decreasing tendency when decreasing vine load, in Merlot samples the tendency is just the opposite: due to yield regulation its maldivin-monoglucosid concentration increases. Based on our measurements it can also be stated that both grape variety and vintage has crucial importance as for the concentration of the examined compound group.

When examining average values of resveratrol components of wines our conclusion is that cluster thinning very often has positive effect on resveratrol- and piceid content of wines, considering the statistical evaluation of the three years (apart from cis-resveratrol content of Merlot wines) there is no significant connection between vine load and the measured values.

Summarizing sensory qualification of wines it can be stated that best quality wines from certain vintages and varieties usually come from yield regulated grapes: from among 12 winners only one was given to a control sample. In four cases category winners were wines of 80% - and in seven cases of 60% vine load. This result shows that in spite of having no significant difference as for analytical and statistical results, yield regulation has great effect on sensory evaluation of wines, which can be considered the most important for consumers and marketing aspects of wines.

The change of climatic conditions on the Earth arises food safety questions, as shifting Mediterranean effects to northern regions is favourable for spreading toxin producing moulds in our country. Having performed two micotoxin monitorings on the two most widespread varieties of the wine region has supported and proven our previous information that by knowing and keeping proper viticulture and viniculture technology we do not yet have to be worried about having Ochratoxin-A és Aflatoxin B1 content in harmful to health amount in our Hungarian wines.

If measuring micotoxins it can be said that during wine aging amount of both added toxins gradually decreases in the wine. Our results from yield regulated levels show that OA and AFB1 monitoring systems are not affected by the yield regulations. Quantity of Ochratoxin-A and Aflatoxin B1 is below detection level in the samples examined by us.

Based on the results of statistical samples it can be stated that in case of red wines colour intensity and colour tone is independent of vine load in each vintage.

Further research task for winemakers is to find connections between the Potassium content of residual soils formed on various volcanic rocks and the quality of the grape planted in the soil concerned. So far potassium content does not seem to decrease from 6-8% down to trace element content and parallelly quality of the wine does not get worse if grown in acidic magmatic soils, intermedier soils, and basic- and ultrabasic rocks (from Tokaj to the volcanos of Rába-line). Good quality wine can be made even if potassium content of the soil is only 2.6%, like on Somló or Sághegy, but at lower potassium content good quality cannot be achieved.

As a summary it can be stated – based on my munerous measurement data - that the expression „yield regulation” is not only a marketing tool to boost prestige, but also a viticultural technology to improve the quality of wine.

5. Publications

IF articles:

Csutorás Cs., Hudák O., **Rácz K.**, Rácz L. [2014]: Technological Experiments for the Enhancement of Glycerol Content in High Quality Wines, Journal of Agricultural Chemistry and Environment, 2014, 3, 48–52. **IF.: 0,54**

Csutorás Cs., **Rácz K.**, Nagy G. Z., Hudák O., Rácz L. [2014]: Large Scale Experiments on the Investigation of the Effect of High Concentrations of Aflatoxin B1 on the Fermentation of Different Wines, Journal of Agricultural Chemistry and Environment, 2014, 3, 41–47. **IF.: 0,54**

Csutorás Cs.–Rácz L.–**Rácz K.**–Fütő P.–Forgó P.–Kiss A.: Monitoring of ochratoxin A during the fermentation of different wines by applying high toxin concentrations. Microchemical Journal 2013, 107, 182-184. **IF.: 3,048**

K. Kanyóné. Rácz, N. Bakos-Barczi, Cs. Csutorás, L. Rácz., M. Kállay. [2016]: Investigation of yield regulation of red grapes on the concentration of some crucial wine components. Agricultural Sciences Vol.7 No.4 2016. **IF.: 0,65**

NON IF articles:

Rácz K., Leskó A., Kállay M.: A szőlő terméskorlátozásának hatása a borok minőségére, Borászati füzetek 2014/1, 27-29.

Conference publications in Hungarian language (summary)

Rácz L., Csutorás Cs., **Rácz K.**: Környezeti hatások vizsgálata – Mikotoxinok-borok, Dobogókő, 2013. 10. 10. II. Környezetkémiai Szimpózium kiadvány 13. oldal.

Rácz K.: „Technológiai Innovációk, illetve a kutatásfejlesztés szerepe az ipari vállalkozások versenyképességének fokozásában” c. tudományos előadói nap – Bioaktív komponensek szerepe a borban illetve azok vizsgálatának módszerei, Eszterházy Károly Főiskola, Eger, 2012. március 21.

Rácz K., Csutorás Cs., Rácz L., Kállay M. – A szőlő polifenol tartalmának változása az érés során. MKE I. Nemzeti Konferencia, Sopron. 2011. május. 22-25.

Rácz K.: Tavaszi Szél Konferencia, Győr, 2012. május 17-20. – A szőlő terméskorlátozásának hatásvizsgálata a borok minőségére

International conference (summary):

Csutorás Cs.–**Rácz K.**–Girán L.–Hudák O.–Rácz L.–Kiss A. (2012): Novel techniques for the removal of ochratoxin A contamination from wine. EFFOST Annual Meeting Montpellier, France, November 20-23.

Csutorás Cs.–**Rácz K.**–Girán L.–Hudák O.–Rácz L.–Kiss A. (2012): Investigation of glutathione during wine making processes. EFFOST Annual Meeting Montpellier, France, November 20-23.

Kanyóné Rácz K., Bakos-Barczi N., Csutorás Cs., Rácz L., Kállay M. ESAS 2016 - European Symposium on Atomic Spectrometry, Eger, Hungary, 30. March – 1. April