

BUDAPESTI CORVINUS EGYETEM
(BUDAPEST CORVINUS UNIVERSITY)

THE POSSIBILITIES FOR THE QUALITY DEVELOPMENT OF EGG
BIKAVÉR

Doctoral dissertation
theses

GÁL LAJOS

**Prepared at the Department of Enology of Budapest Corvinus
University**

BUDAPEST, 2006

PhD School/Program

Name: PhD School of Food Science

Field: Food Science

Head: Prof. András Fekete
Corvinus University of Budapest

Supervisor: Prof. Miklós Kállay
Department of Enology
Faculty of Food Science
Corvinus University of Budapest

The applicant met the requirement of the PhD regulations of the Corvinus University of Budapest and the thesis is accepted for the defence process.

Budapest, 2006. 04. 10.

.....
Signature of Head of School

.....
Signature of Supervisor

1. INTRODUCTION AND THE AIM OF THE WORK

Egri Bikavér is one of the best-known Hungarian red wines. From among the same-named wines produced in Hungary, the largest amount sold is this wine, annually between 75 - 85 thousand hl. Neither the origins of the name of the wine, nor the circumstances of its production and the use of varieties have yet been fully clarified. SUGÁR (1981) puts the attachment of the name *bikavér* to Eger wines around 1851, quoting from the Book of Hungarian Sayings published in 1851: "*Bikavér (...) this is what the strong red wine, for instance that from Eger, is called.*" Szekszárdians like to quote Garay János, who wrote the two words "bika" and "vér" in one word for the first time, in one of his poems, in 1846. During the course of its history, the judgement of Egri Bikavér was very diverse both on the producers' side, as well as with respect to the quality expected by the consumers.

Hungarian wines, among them Egri Bikavér, are sold at low prices. An especially big problem is posed by the fact that the majority of the players in the Hungarian wine business have not yet been able to decide whether to make their activity successful and compatible through the cost minimising strategy, or based on increasing added value. The producers of the Eger wine region have theoretically opted for the second strategy for the production of Egri Bikavér; however, a complete change of attitude has not taken place yet. One of the most important reasons for this is the low solvency of the domestic market. The regulation of the production of Egri Bikavér and Egri Bikavér Superior wines (the limitation of the production area, the use of grape varieties, the quality of the grapes, grape production and wine-making technologies, the classification of grapes and wines, the registration of vineyards, cellars and containers, controlling) has been defined in Decree number FVM 130/2003 XII.30. of the minister of agriculture and rural development as a legal regulation, the modification of which was initiated by EBHT in 2005.

However, the quality and differences in character of Egri Bikavérs on the market does not clearly reflect the quality development efforts, and does not provide sufficient guidance for the customer either. The consumer can and does expect Egri Bikavér to be mirror-clear, of a crimson or deep crimson colour, complex, with a fragrance and flavour containing both fruit and mellowing aromas, fiery, full-bodied, soft, mature, with velvety tannins, and a harmonious general impression, but without being variety- and tannin-dominant. Naturally, in their intensity, complexity and richness, these features of the organs of sensation are to be in harmony with the different levels of regulations, the different qualities also distinguished through their names, Egri Bikavér, Egri Bikavér Superior and Egri Bikavér Grand Superior quality. Thus, when we talk about the sale of wine, or communicate with the consumer in some other way, when defining the quality of the wine, it is important to put the emphasis on the perceived, that is, market, quality.

In my opinion, the quality of wine is influenced and determined by the production area (exposure, attitude, edaphic factors, etc.), the variety (the blending proportions), the vintage and the human factors, that is, the totality of the grape production and wine-making procedures applied. Based on this, the quality development of Egri Bikavér wines is recommended to be carried out in a complex manner, through the simultaneous modification of several factors, within the system of the protection of origins.

The aim of the present paper is to develop such – experiment-based – complex wine-quality development suggestions on the basis of which grape-producers of the Eger wine region can improve the character security, and quality of Egri Bikavér and Egri Bikavér Superior wines through the further development of their system of the protection of origins. Furthermore, its aim is to develop suggestions for the presentation of Egri Bikavér in the prestige wine category, and for the creation of the regulation of Egri Bikavér Grand Superior “Site name” site-selected wine. To provide a scientific foundation for the suggestions, we have looked for answers to the following questions:

1. Can the differences between the sites be demonstrated in the quality potential and character of the wines that can be produced on them? Are the different production areas (sites) of the Eger wine region suitable for the production of individual, “site-selected” wines?
2. At present, producers use 12 varieties for the production and blending of Egri Bikavér, and 10 for Egri Bikavér Superior. The blending test looks for an answer to the following question: in what proportion do we have to blend the most important kinds of the wine region to improve the quality, character security and the communicability of the unique character of Egri Bikavér?
3. Can we improve the quality of Egri Bikavér wines – through the two, outstandingly important elements of grape-production technologies, changing the amount of yield (more exactly, through the cluster-thinning yield limitation), and delaying the date of harvest (with the slight over-ripening of the grape harvest)?
4. Within *fermentation sur marc* red wine-making technology, with how long a period of skin contact can we achieve the establishment of the appropriate colouring agent and polyphone structure, and the improvement of the quality of the wines produced in the Eger Wine region?

2. MATERIALS AND METHODS

2.1. The vineyards and methods of production area examinations

We have examined the effect of six different growing sites of the Eger wine region on the quality of wine, with respect to Kékfrankos type (Blau Fränkisch) (Figure 1, Table 1).

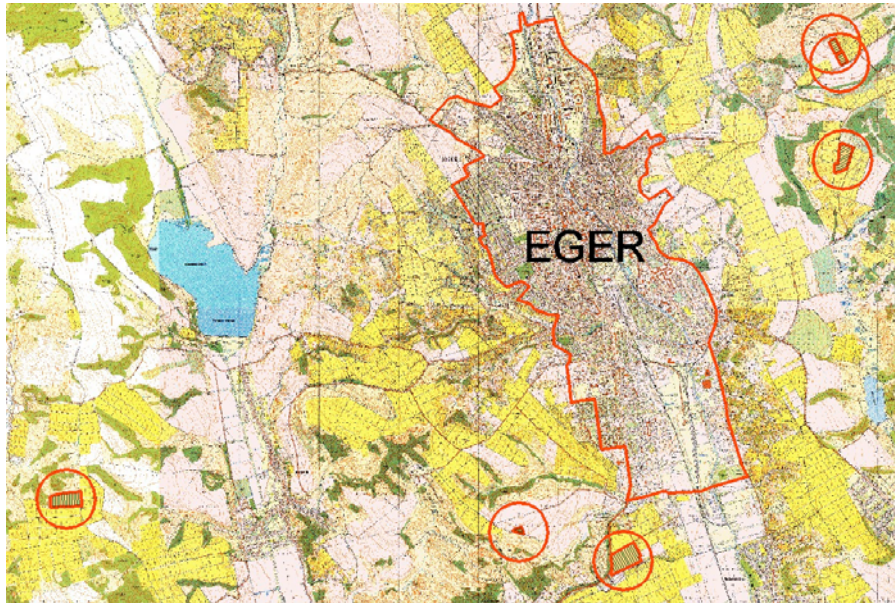


Figure 1: the location of the six production areas in the Eger wine region

Table 1: The most important characteristic features of the vineyards examined between 2002-2004

	Eger, Kőlyuktető	Eger, Nagygalag.	Eger, Nagy-Eged alsó	Eger, Nagy-Eged felső	Eger, Síkhegy	Egerszólát, Tóbérc
Serial number	1	2	3	4	5	6
exposition of slope	N-S	N-S	N-S	N-S	N-S	S-N
Year of plantation	1993	1985	1988	1988	1989	1998
Vine and row spacings (m)	3x1.2	3x1	3x1	3x1	3x1	3x1
Growing area (m ²)	3.6	3.0	3.0	3.0	3.0	3.0
pruning level (bud/m ²)*	6.11	8	8	8	8	4

* The setting of pruning level was followed by the setting of the bunch-load, which was achieved through cluster-thinning, before the bunch-closing state.

We have set up the experiment in all six growing sites on umbrella training system. The root-stock of every experimental parcel was Berlandieri x Riparia T.5C. The soil-physical and chemical analysis of the growing sites were performed by Eszterházy Károly College, Eger, within the framework of the Széchenyi project.

The viticultural practice of the examined sites was similar. We set the date of the harvest for a somewhat overripe state of the grapes. We carried out the harvest on the same or consecutive, precipitation-free days. We carried out the processing of grapes and the production of wine in mezo-vinification (300-400 kg grapes per treatment), with the same technology: destemming → mash-stumming (40 mg/kg SO₂) → inoculation with strain yeast (30g/hl Uvaferm BDX) → nutrition (20g/hl Uvavital) → malolactic fermentation at the beginning of the main fermentation (Uvaferm MLD) → 30-day skin-contact at the same fermentation and skin-contact temperature (18-25°C), with plunging the cap three times a day → pressing with pneumatic press (up to the maximum pressure of 1 bar) → storing in pore-free containers (KOR steel) and glass containers → controlling the malolactic fermentation → the sulphating of the wine after the completion of the decomposition of malic acid to the level of 30 mg/l free sulphurous acid → first and second racking → following self-purification, sensory and analytic evaluation.

2.2. Experiment in the use of varieties for the establishment of the type-composition of Egri Bikavér, the methods of blending and evaluation

The use of varieties is one of the most exciting issues of Egri Bikavér, and one of those that seems the most obvious to the customers. In FVM Szőlészeti és Borászati Kutatóintézete Eger, we create several hundred experimental wines every year, and we also carry out their organoleptic judgement as well. As a method of sensory examination, we applied the 20-point score system in our experiment. We carried out the sensory examination in two phases. At the so-called domestic examination, together with the colleagues of the research institute, we presented and examined those variety true wines in all three experimental years from which we created the different Egri Bikavér blendings. The examination of the variety true wines was followed by the examination of the four Egri Bikavér wines made from the same wines, through “provocative” blendings. We carried out the blending not on the basis of tasting but on previously determined proportions.

The 1st blending reflects the blending proportions that are usual in the present plant practice, or something close to that, the wine-region variety structure planted before 1998. Blending proportions: Kékfrankos (Blau fränkisch) 50%, Kékoportó (Blauer portugieser) 20%, Zweigelt 20%, Cabernet sauvignon 10%.

We created the 2nd blending from four varieties. This was the so-called Cabernet-dominant or world-variety dominant Egri Bikavér. This direction was followed by several top winemakers in the past decade, with the trade of robust, tannin-dominant Egri Bikavér. Blending proportions: Kékfrankos 25%, Cabernet sauvignon 25%, Cabernet franc 25%, Merlot 25%.

The 3rd blending was made from four, exclusively regional varieties, with the exception of the year 2003, when we also used Kékmedoc as the fifth regional variety. Thus not only the varietal characteristic of the mass-production period played a role in this blending but also Blauburger, constituting a new variety, as well as the Kadarka and Kékmedoc varieties, produced in large quantities in previous centuries, before the period of mass-production. Blending proportions: Kékfrankos 40%, Blauburger 25%, Kékoportó 25%, Kadarka 10% (Kékmedoc 5% - in 2003).

We compiled the 4th blending from eight varieties, based on the possibilities constituted by the present and future wine region variety composition. This blending contained regional varieties to approximately 70%, and so-called world varieties to approximately 30%. Blending proportions: Kékfrankos 39%, Kékoportó 15%, Blauburger 8%, Zweigelt 7%, Kadarka 3%, Cabernet sauvignon 12%, Cabernet franc 8%, Merlot 8%.

The reason we have to use “Egri Bikavér” ~~variety-use~~ in quotation marks is that all the wines used for the experiment were produced in micro-vinification, which we then stored in glass containers of different sizes. With this method, exclusively the aromas originating from grapes and fermentation ended up in the wines, so we avoided the influencing effects of aromas from the different aging technologies. Thus we were able to sense the differences originating from the variety use more clearly.

2.3. The setting and methods of yield limitation experiments and experiments related to the harvest date selection

We set the experiment on Blauburger grape variety, which is located at the Kőlyuktető (Eger) production area, with 2x1 meter vine and row spacings, planted in 1993, trained on umbrella system. The pruning level was 6 bud/m², the cluster loading was on average 24 clusters/vine-stock, which we decreased to 1 cluster shoot, on average to 12 clusters/vine-stock. We set the two-factor (cluster thinning and harvest date), two-treatment experiment in random block arrangement, in three repetitions. The marking and meaning of the different treatments:

- I/1: no cluster thinning, first grape harvest date,
- II/1. cluster thinning to one cluster per shoot, first grape harvest date,
- I/2. no cluster thinning, second grape harvest date,
- II/2. cluster thinning to one cluster per shoot, second grape harvest date.

Following the harvest, we prepared the wines with the same technology in the case of every treatment (3x20 kg mash per treatment), according to the following: destemming → mash-sulphating (50 mg/kg SO₂) → inoculation with yeast strain (30g/hl Uvaferm BDX) → nutrition (20g/hl Uvavital) → malolactic fermentation at the beginning of the main fermentation (Uvaferm MLD) → skin contact for 14-16 days at the same fermentation and skin contact temperature, with three plunges of the cap a day → pressing (up to the maximum pressure of 2 bars) → storing in glass containers → controlling the malolactic fermentation → the sulphating of the wine after the completion of the decomposition of malic acid to the level of 30 mg/l free sulphurous acid → first and second racking → following self-purification, sensory and analytical evaluation.

2.4. The methods of the skin contact experiment of the red wine making technology

In the experiment, we examined the effects of the skin contact time on the composition and quality of the wine in the 2002-2004 years. From Kékfrankos variety we used as the basis of the experiment, we made homogeneous mash. We inoculated the mash with UVAFERM BDX variety yeast, then put 3x20 litres of mash per treatment into a separate fermentation container. We performed fermentation *sur marc* in these 20-litre plastic containers, with three plunges of the cap per day. On the 3rd day of fermentation, we inoculated the treatments with UVAFERM MT-01 malic acid decomposing bacterium cultures. According to the names of the wines, we pressed the mashes on the 8th, 14th, 23rd and 30th days. We racked together the free-run juice and the pressed-juice. After the completion of the malolactic fermentation of the wines, we carried out the basic sulphating, then, following self-purification and the second racking, the sensory and analytical evaluation.

2.5. The analytical and sensory examination methods applied

2.5.1. Analytical examination methods

2.5.1.1. Routine analytical examinations

We defined the alcohol contents with the help of the distillation method (MSZ 9458-1972), the sugar contents with the Rebelein method (MSZ 9479-1980), titrable acidity with indicator titring (MSZ 9472-1986), extract contents with the picno-metre method (MSZ 9463-1985), the free and total sulphurous acid contents with iodine-metric titring (MSZ 9465-1985), the volatile acidity with the distillation method (MSZ 9473-1987). The definition of pH values (MSZ 14849-1979) was performed with RADELKIS OP211/2 type pH-metering device.

2.5.1.2. Instrumental analytical examinations

The measurement of the colour intensity of the wines (MSZ 14848-1979), the definition of polyphenol contents (MSZ 9474-1980), and the definition of anthocyanin - and leuco anthocyanin contents (MSZ 14881-1989) was performed with the spectro-photometric method.

- The analyses of anthocyanins with HPLC method
- The definition of tannin indices (PÁSTI, 2003)

2.5.2. Methods of sensory evaluation

The analysis of the sensory characteristics of the wines in the experiment was performed with the 20-point score system and with the help of profile-analysis. The latter method of evaluation is necessary because, while the 20-point method informs about the total impression made of the wines, while the profile analysis also provides a possibility for the detailed analysis of the scent and flavour compounds of the wines. As a matter of fact, it can be interpreted as a 5-point radar plot graph, during the course of which the judges evaluate the selected parameters with points between 0 and 5. With respect to all the items, the averages of the points awarded for the different features are presented in a spider's web graph. In the central point of the graph, the value zero, along the outer circumference of the circle, is 5, the maximum value that can be awarded. The axes constitute the features evaluated, and the "profile" of the wine in question appears when the points located on them are connected. A profile covering an ever larger area and resembling a circle as much as possible makes the impression of a better quality and more harmonious wine.

2.6. The statistical evaluation of the experimental methods with the Holm-Sidak method

When performing the test, the P values of all comparisons are computed and ordered from smallest to largest. Each P value is then compared to a critical level that depends upon the significance level of the test (set in the test options), the rank of the P value, and the total number of comparisons made. A P value less than the critical level indicates that there is a significant difference between the corresponding two groups.

2.7. The influence of the vintages in the experiment

There were significant differences among the years in terms of the amount of precipitation, the annual mean temperatures and the number of sunshine hours as well. SZILÁGYI and colleagues (2005) examined the polyphenol composition of three years of Kékfrankos variety produced in different production areas, with chromatographic methods. With the principal component analysis

of the results (PCA), they concluded that in the polyphenol composition of the wines the influence of the climatic factors was more obvious than the production area effect.

3. RESULTS

3.1. The evaluation of the results of the growing sites experiments

Both on the basis of the analytical examinations, and on the results of the sensory evaluations performed with the profile analysis and the 20-point score system, we can conclude that in 2002 the wines of the Nagy-Eged lower and Nagy-Eged upper sites, in 2003 the Síkhegy, the Nagyeged upper and the Nagygalagonyás sites, in 2004 the Nagy-Eged lower and Nagy-Eged upper sites turned out to be the best. In all three years, the profile-analysis results of the Nagy-Eged lower and the Nagy-Eged upper growing sites show an almost complete unanimity. This confirms the suitability of the growing sites for the possibility of the production of excellent wines independent of the vintage characteristics. Interestingly, the profile-analysis of the Síkhegy growing sites show a spread, while at the 20-point sensory evaluation the wines of the three years received the same number of scores. The sensory descriptive characterisation of the wines of the different growing sites points out the uniqueness and typicality of the wines. On the basis of this, we can recommend the application of site-selection in the Eger wine region both in the case of variety true wines and Egri Bikavér.

Upon the evaluation of the wines of the growing sites by year we have experienced significant differences in the case of several sensory factors, which supports the effect of the growing site on the quality and character of the wine. In our opinion, even with consciously selected grape-production and wine-making technologies, most of the growing sites of the Eger wine region are suitable for the production of excellent-quality Egri Bikavér.

3.2. The evaluation of the results of variety-use experiments

On the basis of the results of the sensory examination of the individual wines and blendings of the varieties making up Bikavér, we can conclude that in all instances the result of the sensory evaluation of the wine of the blendings was higher than that of the basic wines. (Exception: Cabernet Sauvignon 2002/1, 2, and 2003/1, and Kékfrankos 2002/1 blendings.) These results of the experiment well represent the quality-improvement possibilities hidden in the blending of the wines, and prove the centuries-long practice of the producers of the Eger wine region with respect to this.

Egri Bikavér is expected not to have a character referring to a variety or a variety group. Blending number 2 – containing world varieties to 75% - did not satisfy this criterion in any of the years.

In every year, the highest points of sensory evaluation were awarded to blending number 4, containing regional varieties to 70% and world varieties to 30%. This result is in part supported by the statistical examinations, while the ranking established by the scores of the judges makes it unambiguous. Based on this, it seems unavoidable to use the world varieties producing richer fragrance, fuller body and robustness.

Both in its number of points and rank, blending number 3 received the second place. This points out the importance of local or regional varieties, the possibility of producing “unique” Bikavér wines, therefore, the high-level production of local or regional varieties and their blending for Egri Bikavér can be an unavoidable distinguishing feature in the market of red wines.

Based on the results, upon the blending of Egri Bikavér wines, we can recommend the use of the local or regional varieties to some 70%, and that of the world varieties to some 30% in the interest of the development of the quality, the better communication of the blending proportions, the increase of the homogeneity and character-stability, and eventually the market success, of Egri Bikavér wines.

3.3. The evaluation of the results of the experiments related to yield limitation and the selection of the harvest time

As a result of cluster-thinning, the amount of yield decreased significantly at both harvest dates of all years. The decreasing of yield achieved through cluster thinning performed during the period of cluster closure had a definite positive effect on the quality of the wine; this is proven by the fact that, as a result of the decrease in yield, the alcohol and sugar-free extract contents of the wines, as well as the colour intensity and the total polyphenol contents, have increased.

In an unfavourable vintage, we experienced that the decrease of yield mitigated the influence of the vintage, while in a year with favourable weather conditions we experienced that it reinforced the positive effects even further.

The later date of harvest (unless the weather circumstances – long-lasting rain, black rot – make it impossible) has a positive effect both on the analytical parameters and the sensory characteristics of the wine.

The pruning level applied in the experiment (6 buds/m²) was high, while the cluster-thinning yield limitation was of a small extent, resulting in a harvested amount of altogether 13.9 t/ha in the three treatments producing the quality wines. In the case of the production of superior wines maximised at 8 t/ha yield quantity, or that of grand superior wines maximised at 4-6 t/ha – as

recommended by us – a pruning lower than this and a more significant restriction of yield is necessary.

3.4. The evaluation of the skin contact experimental results of the wine-making technology

The experiments of the three years prove undoubtedly, that at least three-week long maceration is not the only condition of higher quality wine-making with stable colour and tannin materials. The concentration of the tannins and anthocyanins in the grape berry, that is the phenolic ripeness of the grape, which is heavily year-, production-area- and technology-dependent, is an important factor.

In an unfavourable year, the period of phenolic ripeness falls far behind the state of technological ripeness, therefore, at this time, the polyphenol compounds are present in the grapes in an insufficient quantity and mainly in an insufficient quality. As the molecules participating in the polymerisation processes are absent from the grapes, a shorter period of skin contact is sufficient, as wines of higher quality cannot be produced even with maceration for a longer time.

In a favourable year, however, we can harvest the grapes in the suitable state of phenolic ripeness, therefore, the active, small, and intermediate molecule tannins, as well as the less reactionary, larger molecule-volume tannins can be found in the grape berries, which, having gone through the polymerisation reactions taking place during the course of the at least three week long skin contact, form the stable colour and tannin structure of the wine.

In addition to the technological and phenolic ripeness state of the grapes, the at least three-week long maceration proved to be a sufficient technology for the production of Bikavér Superior basic wines.

The results of the analytical and sensory evaluation of the wines of the experiment, particularly the gelatine and hydrochloric acid index values, prove that a skin contact period longer than usual (14-23 days), even in the case of the low polyphenol-content Kékfrankos, can be applied for the creation of a wine that is suitable for a longer period of aging, with stable colours and a good polyphenol structure.

3.5. New scientific results

1. In Hungary, and within that, in the Eger wine region, the issue of grapevine-growing site classification, applied in the 18-19th centuries, keeps coming back. This is necessary primarily in the interest of the production of the “site-selected” wines of protected origins. In addition to the survey of the growing sites eco-potential applied so far, based on the results of our experiments, we consider the complex analytical and sensory evaluation of the wines of a site a good supplementary method for the scientific support of the classification of production areas.

2. The results of the growing sites experiments prove that differences can be demonstrated among the sites – in addition to the micro-climactic factors, soil properties – in the quality and character of the wines produced on them. Based on this, the repeated classification of the growing sites, and for the producers of the wine region, the production of site-selected wines of protected origins, becomes possible.

3. Based on the results of the blending experiments, for the blending of Egri Bikavér we can recommend the use of local or regional wines to some 70%, and the world varieties to some 30% in the interest of the improvement of the quality and character stability of the wine, as well as that of market success.

4. With dense vine and row spacings, large-cluster varieties, the 6 buds/m² pruning level – so far considered low – proved to be high even with cluster-thinning. For the production of wines of higher control level, with a protected origin, we recommend a lower pruning level, 4 buds/m² and produce limitation performed with more powerful cluster thinning. The results of the experiment prove that a conscious producer may, in advance, plan the order of factors influencing wine quality, according to the desired wine quality (with the exception of the weather). On the basis of this, we can establish that no ranking can be set up in general among the factors influencing wine quality.

5. Within the red wine making technology, based on the results of the hydrochloric acid- and gelatine-index of the experiment aimed at the correct selection of the period of skin contact, we can establish that a longer period of skin contact (14-23 days) results in sufficient polyphenol and tannin structures for the wines, even in Kékfrankos wines with a relatively low total polyphenol contents in average or good years.

4. CONCLUSIONS AND SUGGESTIONS

The quality development of Egri Bikavér wines is timely because, on the one hand, wines of heterogeneous quality and character can be found on the market of lower price category wines, on the other hand, the further development of the system of the protection of the origins of the Eger wine region is also necessary. In addition to the quality development of Egri Bikavér and Egri Bikavér Superior wines, the presentation of Egri Bikavér as a prestige wine can be recommended by the development of the site-selected Egri Bikavér Grand Superior wine.

In the literature overview section of the dissertation, without striving for totality, I processed the related literary references of factors influencing wine quality, the production area, the use of varieties, and the grape production and wine-making technologies. I carried this out based on the history of the production area and use of varieties, grape production and wine making technologies of the Eger wine region by simultaneously evaluating the research results of recent years. In the

dissertation I put emphasis on the analysis of the influence of the year of the grape production, and wine-making experiments, supposing that these have a significant effect on the quality of the wines, as the Eger wine region is located close to the northern borderline of the grape production zone. It is also not insignificant that, as a result of the climate changes of the past decade, the influences of the vintage have become hectic. These analyses are important for the evaluation of an experiment forming a part of the dissertation in spite of the fact that they were carried out at different time intervals and can be evaluated independently.

The factors influencing the quality of the wines work together, therefore, in the interest of the complex approach of quality development, we carried out the tasks detailed under objectives.

4.1. By building on the experiments carried out between 1996 and 2001 (the results of these can be found in the literature overview), between 2002 and 2004, with support from NKTH, within the framework of the so-called Széchenyi project, we examined the effects of six different growing sites of the Eger wine region on the quality of Kékfrankos wine. Based on the results, we have made the following conclusions:

- At the six different growing sites, wines of different quality and aging potential were produced in all three years.
- The six growing sites – upon the similarities of the two Nagy-Eged sites - lent a different unique character to the wines produced there.
- We can state that upon the establishment of new plantages, the selection of the growing site plays an important role in the formation of the planned wine quality. In the case of the existing vineyards, with our results we pointed out the possibility of the choice of the correct wine production philosophy.
- Our results reinforce the requirement of the re-classification of growing sites (in the 18th – 19th centuries there was a system like this operating in Eger), as well as make the production of site-selected wines to be incorporated in the origin-protection system of the Eger wine region possible.

4.2. The quality of Egri Bikavér wines – due to their differences in character - is heterogeneous. At present, in the wine market, we can find Egri Bikavér wines of different character, from the kind characterised as “one-sided, Kékfrankos dominated” to full, full-bodied, robust, “but rather the Bordeaux blend” quality. In the interest of the communicability of wine quality, character stability and variety use, we carried out blending experiments in three years. On the basis of the results we can state:

- The blending of three years of 12 Egri Bikavér wines – with the exception of four cases – received higher sensory evaluation scores than the altogether twenty-five variety true wines

of the three years. This proves the several centuries-long practice of the producers of the Eger wine region with respect to the quality-improvement effect of blending.

- We achieved the greatest increase of sensory values in the case of the blending of regional varieties, in all three years.
- In the interest of the enforcement of the “Eger character” - based on Kékfrankos - we recommend to use the regional varieties (Blauburger, Portugieser, Kadarka, Kékmedoc) in the wines to a greater degree, some 70 %. In addition to this, in the interest of the creation of the robust nature of the wines, from among the world varieties, we recommend using Merlot, Cabernet franc and Cabernet sauvignon to some 30%.
- With our suggestions, we can increase the quality of the wines, their character stability, and the better communicability of variety use.

4.3. We examined the effects of the two important elements of grape production technology: cluster-thinning production limitation and the selection of harvest dates, more precisely the effects of later harvest dates, in a five-year long content experiment (1998-2002). We carried out our experiment on the large-cluster, new, regional grape variety, Blauburger, in a 2x1 meter vine and row spacings vineyard on umbrella cultivation training system, with 6 bud/m² pruning level.

- In a vineyard with such a dense vine and row spacing and large stock number, on this large-cluster variety, the 6 bud/m² pruning level was high even with the yield limitation performed with significant cluster-thinning, therefore – depending on the condition of the vineyard – a lower, 4 bud/m² pruning level is recommended, upon cluster thinning, in line with the expected yield amount.
- As a result of the decrease of the cluster loading, the amount of yield decreased significantly, while the quality of wine increased in every class.
- Delaying the date of the harvest had a favourable effect on the quality of the wine only in good vintages.
- The negative effect of weaker vintages can be reduced with the suitable limitation of the yield, while the positive effect of good vintages can be increased.

4.4. Within the winery experiments, we examined the effects of the period of *fermentation sur marc* and skin contact on the quality of Kékfrankos in three years. We can establish the following:

- In case of grapes of unsuitable quality, we do not recommend choosing the longer term skin contact technology, as in the case of these there is no opportunity for the improvement of the polyphenol structure (year 2004).

- Longer than usual skin contact (14-23 days) can be applied even in the case of the lower polyphenol content Kékfrankos, to create a wine that is suitable for a longer period of aging, with stable colours and good polyphenol structure in mediocre or good years.

4.5 Suggestion for the complex development of the quality of Egri Bikavér wines

On the basis of our results, we are making the following suggestions for the regulation of the production of Egri Bikavér wines, for the modification of FVM Decree number 130/2003 XII.31., and the presentation of Egri Bikavér in the prestige wine category through the creation of Egri Bikavér Grand Superior “Site name” site selected wine.

Egri Bikavér wine with protected origins (recommendation for the modification of valid professional regulations)

- The yield amount should be 10-12 t/ha at most.
- Variety use, blending proportions: depending on the year, EBHT permit, by 20 August, the use of Turán and Báborkadarka colouring juice varieties on condition that their blending proportion is 10% most, even combined. In order to achieve the “Eger character” and character stability, we recommend that approximately 70% regional and approximately 30% world varieties be used.

Egri Bikavér Superior wine with protected origins (recommendation for the modification of valid professional regulations)

- In order to achieve the “Eger character” and character stability, we recommend that approximately 70% regional and approximately 30% world varieties be used.
- Winery technology: the period of time of *fermentation sur marc* should be at least 21 days.

Egri Bikavér Grand Superior “Site” site-selected wine with protected origins (recommendation for the professional regulation of a new wine belonging to the prestige category)

- The name of the wine: Egri Bikavér Grand Superior “Site”.
- Geographical origins: the production area or site is located in the Eger wine region of the Eger district, identifiable with topographical lot numbers, easily circumscribable in a natural way (roads, creek, valley, mountain ridge), under an independent name, in possession of at least 300-point production area value. For economic reasons, only such sites are recommended for the production of the wines which produce the at least 20 Mm° sugar-content grapes upon 4-6 t/ha yield quantity with certainty, even in the weaker vintages (e.g. 2001, 2004).
- The use of grape varieties. The wine can be produced from the blending of the yield of the following grape varieties, grapes and/or wines: Kékfrankos, Portugieser, Blauburger, Kadarka, Kékmedoc, Cabernet sauvignon, Cabernet franc, Merlot. (The experiments of the thesis did not

include these but from among the varieties yielding good quality – proven by other experiments – we recommend Pinot noir and Syrah varieties.)

- The rules of blending. In the interest of complexity, the use of at least five varieties is necessary for the blending. The proportion of one variety can be at least 5%, and not more than 40%. In order to achieve the “Eger character” and character stability, we recommend that approximately 70% regional and approximately 30% world varieties be used.

- Grape-production technology. The amount of produce can be 4 t/ha at most. Upon the suggestion of the consortium of producers, Egri Bikavér Grand Superior site selected wine, approved by Egri Borvidék Hegyközségi Tanácsa, this limitation can be modified, depending on the vintage, by 20 August of every year, by up to 6 t/ha maximum.

- Winery technology: the period of time of *fermentation sur marc* should be at least 21 days.

5. PUBLICATIONS RELATED TO THE SUBJECT OF THE DISSERTATION

1.1 Articles published in journals

1.1.1 IF articles published in journals

Laszlavik, M., **Gál, L.**, Misik, S., Erdei, L. (1995) : Phenolic Compounds in Two Hungarian Red Wines Matured in *Quercus robur* and *Quercus petraea* Barrels : HPLC Analysis and Diode Array Detection. **American Journal Enol. Vitic. Vol.46, No.1, p. 67-74.**

1.1.2 Non-IF articles published in journals

Gál, L., Misik, S. (1997): Az Egri és a Bükkaljai borvidék szőlőültetvényeinek jellemzése. **Borászati Füzetek, 1997/3 p.**

Gál, L., Bálo, B., Orbán, S., Kiss, A., Pók, T., Gál, T. (2003): Az Egri Bikavér mint hungarikum versenyképességének növelésével és eredetvédelmével kapcsolatos kutatások és technológiai fejlesztések. **Egri Bikavér Bulletin p.6.**

Gál, L. (2003): Az Egri Bikavér eredetvédelme. Egri Bikavér Bulletin. Egri Szőlészeti Borászati Szolgáltató Kht. Eger 7. p.

Pelle, B., Lázár, I., Thummerer, V., **Gál, L.**, Dula, B. (2003): Egri Bikavér évjáratok bor minősítése. **Egri Bikavér Bulletin** Egri Szőlészeti Borászati Szolgáltató Kht. Eger 36 – 37. p.

1.2 Conference publications

1.2.1 Hungarian-language summary

Gál, L. , Misik, S. (1996): Az Egri borvidék eredetvédelmi rendszerének kialakítása. **V. Agrárökonómiai Tudományos Napok, Gyöngyös, március 26-27. Proceedings Volume 1. p. 195.**

Pásti, Gy., Lőrincz, Gy., **Gál, L.** (1996): Speciális kékszőlőfeldolgozási technológiák alkalmazása az Egri borvidéken. **Lippay János Tudományos Ülésszak, KÉE Budapest, október 17-18. (előadás)**

Gál, L. (1998): Földrajzi árujelző oltalom-eredetvédelem az Egri borvidéken. **VI. Nemzetközi Agrárökonómiai Tudományos Napok, Gyöngyös, márc.24-25. Proceedings Volume 2. 1. p.**

Gál, L. (1998): A különböző termőhelyek hatása a Kékfrankos bor minőségére az Egri borvidéken. **Lippay János - Vas Károly Tudományos Ülésszak , Budapest, szeptember 16-18. (poszter)**

Kállay, M., Pásti, Gy., **Gál, L.** (1998): Hosszú idejű héjonáztatás alkalmazása a vörösborok készítésekor. **Lippay János - Vas Károly Tudományos Ülésszak , Budapest, szeptember 16-18. Proceedings p. 16.**

Barócsi, Z., **Gál, L.**, Nagy, K., Balogh, I. (1998): A tőketerhelés és a minőség összefüggései az Egri Bikavért adó szőlőfajták termelésében. **Lippay János - Vas Károly Tudományos Ülésszak , Budapest, szeptember 16-18. (poszter)**

Gál, L., Romenda, R. (2000): A Blauburger szőlőfajta termesztési és borászati értékeinek vizsgálata Egerben. **Lippay János - Vas Károly Tudományos Ülésszak , Budapest, November 6-7. Proceedings p. 520.**

Gál, L. (2001): A fahordó reneszánsza. **II. Szőlészeti-Borászati Továbbképző Konferencia Eger, 2001. január 18. 2.p.**

Gál, L. (2001): A termés csökkentés hatása a Blauburger bor minőségére. **Magyar Tudomány Napja, Eger, november, MTSZ Heves Megyei Szervezete Tudományos Közlemények 4. p.118.**

Gál, L. (2003): Fajtaösszetétel-borminőség összefüggése az Egri Bikavér esetében. **Lippay János – Ormos Imre – Vas Károly Tudományos Ülésszak Budapest, november 6-7. (poszter)**

Gál, L., Bálo, B., Orbán, S., Kiss, A., Pók, T., **Gál, T.** (2003): Az Egri Bikavér minőségfejlesztésének termőhelyi és technológiai lehetőségei. **Lippay János – Ormos Imre – Vas Károly Tudományos Ülésszak Budapest, november 6-7. Proceedings p.54.**

Szilágyi, Z., **Gál, L.** (2005): Vörösborok vizsgálata kromatográfiás módszerekkel. **LOV Tudományos Napok, Budapest 48. p.**

1.2.2 International conference - complete

L.Gál, B.Bálo, S. Orbán, A. Kiss, T. Pók, T. Gál (2003): Development of appellation origin control system of Egri Bikavér. **Colloque International. Paysages de Vignes et de Vins. Fontevrand, France, 2-4 July, Proceedings p. 35.**

GÁL, L., Bálo, B., Szűcs, E. (2006): Variety composition of "Egri Bikavér" on the basis of several blending experiments. **Proceedings of the XXIXth World Congress of Vine and Wine, 4th General Assembly of the O.I.V., Logrono, Spain, 25-30 June, p.39.**

Gál, L., Orbán, S., **Gál, T.**, Pók, T., Szilágyi, Z., Szűcs, E., Zsófi, Zs. and Bálo, B. (2006): Terroir aspects in development of quality of "Egri Bikavér". **Proceedings of the VIe Congres International des Terroirs Viticoles. Bordeaux-Montpellier, France, 3-7 July. p. 509-515.**

1.2.3 International conference - summary

Gál, L., Lőrincz, Gy. (1995): The Effect of Two Hungarian Quercus Species on Red Wine by Ageing in New Oak Barrels. 5^e Symposium International d' Oenologie, Bordeaux, Editions TEC&DOC p. 438.

Gál, L. (1998): Földrajzi árujelző oltalom-eredetvédelem az Egri borvidéken. VI. Nemzetközi Agrárökonómiai Tudományos Napok, Gyöngyös, március 24-25. Proceedings Volume 2. p. 1.

1.. Book and detail of book in hungarian language

Gál, L. (1997): Szőlőtermesztés és borkészítés az Egri borvidéken. Egri Borok Könyve

2. Other scientific activities (K+F applications):

2.1 Won hungarian K+F applications, leader of themes:

Gál, L (1997-2002): Új borászati technológiák alkalmazása az Egri borvidéken. Beszámoló jelentések a Földművelésügyi és Vidékfejlesztési Minisztérium részére. A téma azonosító száma: 030009.

T-16/3/2000. Az Egri borvidék mikrokörzetei ökopotenciáljának vizsgálata a minőségi bortermelés érdekében

64-d/2002. Az egri borok irányított erjesztés-technológiájának fejlesztése és mikrobiológiai stabilitásának biztosítása (2002-2003)

94-95-43-0014 Barrikos érlelésű különleges minőségű egri vörösborok előállítása (1994-1996)

2.2 Won hungarian K+F applications, participants of themes:

Gál, L (1995): Az Egri borvidék eredetvédelmi fejlesztése In: BOTOS E. (Szerk.) A magyar borok származás- és eredetvédelmét biztosító rendszer kialakítása a teljes bor vertikumra. Zárójelentés Kecskemét 158 – 205. p.

Orbán, S., Kiss, A., **Gál, L.**, Bálo, B., Gál, T., Pók, T. (2005): Zárójelentés. OM 00335/2002. számú szerződés. Az Egri Bikavér, mint hungarikum versenyképessége növelésével és eredetvédelmével kapcsolatos kutatások és technológiai fejlesztések.

2.3 Diplom dissertation and scientific students dissertation

Gál, L (1976): A szőlőhajtás és levél ásványi anyag és szénhidrátforgalma a vegetációs időszak alatt, különböző rügyterhelések mellett a Mátraaljai borvidék néhány jellemző fajtájánál. TDK dolgozat Kertészeti Egyetem Főiskolai Kara, Gyöngyös

Gál, L (1986): Szőlőfeldolgozó üzem tervezése az Egerszalóki Termelőszövetkezetben. Diplomadolgozat - KÉE Budapest

