

PhD thesis

**EXAMINATION OF EXTENZIGRAPHICAL AND ALVEOGRAPHICAL
PARAMETERS OF WINTER WHEAT VARIETIES**

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1. RESEARCH OBJECTIVES

Nowadays, there is a growing claim for the special rheological examinations, mostly for the extensibility and resistance of extension parameters both in the international and Hungarian wheat export markets.

We have to analyse the alveographical and extensigraphical parameters of Hungarian growing winter wheat to help to realize the alveographical and extensigraphical quality and qualification. The correlation among some quality parameters can give us extra information about backing values of winter wheat varieties, selection of special quality types for wheat growing and qualification of the different export rate.

The objectives of my dissertation were the followings: first of all the examination of alveographical and extensigraphical parameters of winter wheat varieties in Szeged breeding station, which were originated from Kecskés Station of Cereal Research Non Profit Company, as well as the categorisation of analysed varieties in a special baking industry value-scale, effect examination of variety and cropping year and the exploration of correlation among the analysed parameters to give useful results for mill- and baking industrial practice.

2. PRECEDENTS

Quality examination of winter wheat and flour is important for research and practice. Quality directed approach and quality oriented breeding came to the front in Hungary in the 90s'.

The wheat standard, which came into operation in 1979, classified the wheat rates as the following parameters: purity, hl mass, wet gluten content, gluten expansiveness, baking value. The international claims demand often other qualifications. The Hungarian Wheat Standard with market requirements was enlarged with limit of protein content Zeleny index, falling number by Hagberg in 1998, so the Hungarian qualification system specifies one quality rate with 9 parameters.

There is a claim for special rheological examinations in the international and Hungarian wheat market, too. These parameters are the alveographical and extensigraphical values, which are analysed more and more in Hungary and the foreign market.

The traditional wheat quality examinations parallel to break-extensibility examinations of dough are used more and more in industry and more often in laboratories.

“Pannon Project”, which is an export directed R+D (research and development) complex quality research consultation system, was founded to develop the international competitiveness of Hungarian cereal verticum in Hungary. It was based on the successful international quality management system in wheat industry and the quality parameters of Hungarian wheat. According to these standpoints the Pannon Premium and Pannon Standard quality criteria system were launched with the important parameters of alveographical W, P/L and the extensigraphical energy values in 135. relaxing time.

We have to analyse the alveographical and extensigraphical parameters of Hungarian growing winter wheat to help to realize the alveographical and extensigraphical quality and qualification. The correlation among some quality parameters can give us extra information on backing values of winter wheat varieties, selecting of special quality types for wheat growing and qualification of the different export rate.

3. RESEARCH METHODS

The analysed winter wheat samples, which were produced in 2005-2007, originate from Kecskés breeding station of the Cereal Research Non Profit Company.

3. 1. Circumstance of experiment

The field has loamy alluvial soil. The field of plots were 20 m²/plot without repetition every year. The stubble ploughing and fertilizer were used in autumn in vegetation period. We analysed the following important parameters: Brabender extensigraphical resistance to extension, extensibility, energy, extensibility ratio number, SMS2 TA (Stable Micro System Texture Analyser) (Kieffer) resistance to extension, extensibility, subarea, extensibility ratio number, Chopin alveographical P, L, P/L, G, W and SMS2 Texture Analyser (Dobraszczyk) P, L, P/L, W.

3. 2. The analysed samples

The analysed 25 winter wheat samples were produced in 2005-2007, originated from the Kecskés breeding station of the Cereal Research Non Profit Company. I analysed only the 10 representative varieties (GK Élet, GK Kalász, GK Hattyú, GK Garaboly, GK Petur, GK Verecke, GK Piacos, GK Csongrád, GK Csillag, GK Kapos), which were grown in Szeged breeding station in those three years and I managed to analyse in these years, too.

3. 3. Laboratory quality examinations

Table 1: Methodes and instruments in analysis

Examination	Method	Instrument
Moisture content	MSZ 6369/4-1987	LP 303 type dryer machine
Examination by Farinograph	MSZ 6369/6-1998	Brabender farinograph
Extenzigraphical examination (Brabender)	ISO 5530-2:1997	Brabender extensigraph
Kneading for Extenzigraphical examination (Kieffer)	Making of formulation as specification of Kentucky Pizza Hut food chain	Metefém FQA 205 type valorigraph
Extenzigraphical examination (Kieffer)	According to Kieffer's method	SMS2 Texture Analyser (Kieffer)
Alveographical examination (Chopin Alveograph)	AACC-1983.54.30	ALVEOGRAPH NG (CHOPIN, Villeneuve-la-Garenne, France)
Kneading for Alveographical examination (Dobraszczyk)	ISO 5530-4:1991	Chopin MR 2L Rotary Mixer
Alveographical examination (Dobraszczyk)	ISO 5530-4:1991	SMS2 Texture Analyser (Dobraszczyk) D/R system

The laboratory examinations with Brabender extensigraph and SMS2 TA (Stable Micro System Texture Analyser) (Kieffer and Dobraszczyk) were completed in the accredited Laboratory of ABO-MILL ZRt. in Törökszentmiklós.

The Chopin alveographical examinations were performed in the Laboratory of Department of Food Science Quality Assurance, in Faculty of Agronomy, University of Debrecen Centre for Agricultural Sciences and Engineering.

Production of flour was made according to MSZ 6367/9:1989 Standard with LABOR MIM FQC 109 instrument. We used LABORATORY MILL CD 1 (CHOPIN, Villeneuve-la-Garenne, France) type laboratory mill to Chopin measurement. We made the laboratory examinations according to the valid Hungarian and ISO standards and analysis method in the technical literature (*Table 1*).

3. 4. Statistical method for the evaluation of experiment

I counted significant difference from the analysed values with two-way ANOVA and I managed to examine the effects of variety and cropping year. I searched the correlation among alveographical and extensigraphical parameters with Pearson correlation analysis.

I used one-and stepwise regression analysis to make estimating equations among the parameters.

I used Excel for Windows and SPSS 12.0 for Microsoft Windows program to evaluate the results of experiments and examinations.

4. MAIN FINDINGS OF THE THESIS

4. 1. Extensographical quality of the analysed winter wheat varieties

According to these standpoints the Pannon Premium and Pannon Standard quality criteria system were launched with the important parameters of alveographical W, P/L and the extensigraphical energy values in 135. relaxing time.

According to the claim of market and practical work, I established that -during the 135. min Brabender extensigraphical examination- GK Kalász and GK Élet varieties showed high resistance of extension, energy and extensibility ratio number. GK Garaboly variety presented low resistance of extension, energy and extensibility ratio number parameters. GK Memento

had high extensibility and energy values. GK Kapos showed low extensibility and energy parameters.

The examinations with SMS2 TA (Stable Micro System Texture Analyser) Kieffer show more inhomogeneous situation, more than with Brabender parameters. GK Hattyú had high resistance of extension, extensibility ratio value and low extensibility values. GK Piacos presented high extensibility and subarea parameters. GK Csongrád showed high extensibility, subarea and low extensibility ratio number. GK Garaboly produced low resistance of extension and extensibility, GK Kapos low resistance of extension and subarea, too.

4. 2. Alveographical quality of the analysed winter wheat varieties

GK Kalász presented high W, P, P/L, GK Petur high L and G, GK Garaboly low alveographical parameters (accept L value) and GK Csongrád and GK Tisza high L, low P/L characteristics value during Chopin alveographical examinations. The examinations with SMS2 TA (Stable Micro System Texture Analyser) Dobraszczyk showed inhomogeneous situation, as with Kieffer, too. GK Rába presented high P, P/L and low W, GK Miska high W and L, GK Hattyú low W, P and L parameters.

4. 3. Examination of variety and cropping year effect

During the laboratory examinations I analysed the effect of variety and cropping year (*Table 2*) The variety had not significant effect on Brabender extensibility resistance of extension, extensibility value, Kieffer extensibility and Dobraszczyk W but the cropping year had high influence only on Brabender extensibility and Dobraszczyk W value and on other parameters not. I established that the varieties showed different values in different years comparing them to the given parameters. We evaluated the significant effect of cropping year in some cases with stepwise analysis. The reason of variability is to be searched in the cumulative effect of variety and cropping year and the factors of agrotechnology, biology and ecology.

Table 2: Variety and cropping year effect on extensographical and alveographical parameters

Paraméterek		Fajthatás	Évjáráthatás
Brabender extensigraph	resistance to extension	no significant	no significant
	extensibility	significant	significant
	energy	significant	no significant
	ratio number	no significant	no significant
SMS2 TA (Kieffer)	resistance to extension	significant	no significant
	extensibility	no significant	no significant
	subarea	significant	no significant
	ratio number	significant	no significant
Chopin alveograph	W	significant	no significant
	P	significant	no significant
	L	significant	no significant
	P/L	significant	no significant
	G	significant	no significant
SMS2 TA (Dobraszczyk)	W	no significant	significant
	P	significant	no significant
	L	significant	no significant
	P/L	significant	no significant

4. 4. Categorisation of analysed winter wheat varieties according to extensographical and alveographical qualification

According to the data of some Hungarian and foreign references and our own experience as well as claims of cereal market costumers, I set up a separated values-scale for the 135. min Brabender extensographical parameters and the data was measured by Chopin alveographical values (table 3 and 4). I specified the analysed parameters with different points and I grouped the varieties in different baking industry categories every year, on the basis of the total points. It was an important point of view that the examined years had different climate basis. I established that GK Kapos, GK Csillag and GK Garaboly are suitable for the production of cracker, GK Csongrád for special baker's ware and the other varieties proved to be improving

quality category in the values-scale with 135. min Brabender energy. I regarded W and P/L parameters equally important during the Chopin alveographical examinations according to the claims of market. GK Kapos is in cracker category in alveographical values-scale

Table 3 : Extensographical baking category of the analysed winter wheat varieties (135. min)

Extensographical parameters	0 point (weak quality)	1 point (cracker)	2 point (traditional bread, paste)	3 point (special bakers' ware, raised dough)	4 point (improver quality)
Resistance to extension (BU)	<100	100-200	201-350	351-550	550<
Energy (cm²)	<50	50-80	81-100	101-120	120<
Category limit as summa point	<3,0	3,0-4,0	4,1-5,4	5,5-7,0	7,0<

Table 4: Alveographical baking category of the analysed winter wheat varieties

Alveographical parameters	0 point (weak quality)	1 point (cracker, pulverised flour, pastries)	2 point (traditional bread, paste)	3 point (rolls)	4 point (pizza, sponge fingers, roll)	5 point (curiosity roll fs. hamburger)	6 point (improver quality)
W value (×10⁻⁴J)	<80	80-160	160-220	230-270	270-330	330-360	360<
P/L value	<0,40 1,0<	0,40-0,50	0,51-0,60	0,61-0,70	0,71-0,80	0,81-0,85	0,85-1,0
Category limit as summa point	<2,5	2,5-4,0	4,1-5,5	5,6-7,0	7,1-8,5	8,6-10,0	10<

4. 5. Correlation analysis among the extensigraphical and alveographical parameters of analysed winter wheat

I analysed the following statistical relationship among the analysed parameters with Person correlation analysis:

- Brabender extensigraphical resistance of extension, extensibility, energy, extensibility ratio number parameters with each other as analysed parameter in the three relax time, the measured Brabender extensigraphical resistance to extension in the 90. and 135. minutes with Brabender extensigraphical energy in all three times, the 90. and 135. minutes measured Brabender extensigraphical energy stay in middle and close correlation with the Brabender extensigraphical extensibility ratio number in the three relax times .
- Chopin alveographical W has close and significant close correlation with P value, Chopin alveographical W stays in middle relation with P/L and Chopin alveographical P.

4. 6. Regression analysis among the extensigraphical and alveographical parameters of analysed winter wheat

I took data of these three years into consideration and I used one-and stepwise regression analysis to be able to make estimating equation among the parameters.

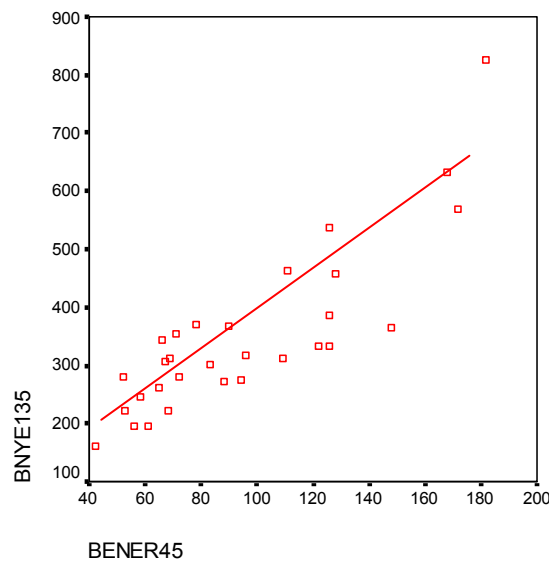
I specified from the results of Chopin alveographical W and P/L and Chopin alveographical P and L with one regression analysis that the probability of estimate was 61,9 % in the first situation and 63,5% in the second case. I could not stay an estimating equation because of the low values. I can stay an equation among the rest of the parameters which were in very strong and strong relationship. The values of determination coefficient and precision of estimate showed optimal parameters (over 70%).

Important relation for practical work the follow equation:

$$135' \text{ BEnye(BU)}=51,064+3,148*45' \text{ BEe (cm}^2\text{)}$$

remark: BEnye= Brabender extensographical resistance to extension, BEe= Brabender extensographical energy

In essence, the value of Brabender extensographical resistance to extension measured in the 135. minute can be estimated well from the Brabender extensographical energy measured in the 45. minute. I present the correlation of analysed parameters on the *Graph 1*.



Graph 1: Relationship between in 135. minute resistance to extension and in 45 minute Brabender energy

As a summary, I can present that I analysed the Brabender and Kieffer extensographical and Chopin and Dobraszczyk alveographical parameters of winter wheat varieties in Szeged breeding station, which were originated from Kecskés Station of Cereal Research Non Profit Company. On the basis of the data in the three years I analysed the climate and variety effect on quality. I established that the varieties showed different parameter in different years.

From the information of references and my own experience, I managed to set up an alveographical and extensographical values-scale. With the help of points I established the quality of varieties every year and on the basis of the total points I specified the use of them for baking industry. I established the correlation, correlation system of alveographical and extensographical parameters and the estimating equations.

I will have to state precisely the causes of climate and varieties additive effect on analysed Brabender extensigraphical parameters, the limit of value-scale by Dobraszczyk and Chopin alveographical parameters and the using of winter wheat varieties in baking industry. I will have to do more research from winter wheat samples of more cropping site and more cropping year to establish that the results can be used in baking practice.

5. NEW AND NOVEL RESULTS OF THE THESIS

- I analysed the extensographical and alveographical parameters and I established that the climate effect on Brabender extensographical extensibility and SMS2 TA Dobraszczyk W was significant.
- I established, that the variety effect was significant effect on every parameter, except Brabender extensographical resistance to extension, extensibility value, extensibility and SMS2 TA Kieffer extensibility and Dobraszczyk W.
- I set up a baking object using value-scale, category to analyse the extensographical and alveographical parameters.
- From the date analysed in 2005-2007 I established that Brabender extensigraphical resistance of extension, extensibility, energy, extensibility ratio number parameters with each other as analysed parameter in the three relax time, the measured Brabender extensigraphical resistance to extension in the 90 and 135 minute with Brabender extensographical energy in all three times, the 90 and 135 minute measured Brabender extensigraphical energy stay in middle and close correlation with the Brabender extensigraphical extensibility ratio value. in the three relax times. Chopin alveographical W has close and significant close correlation with P value , Chopin alveographical W stays in middle relation with P/L and Chopin alveographical P.

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6. PRACTICAL USE OF THE RESULTS

- I analysed different results during rheological examinations with similar principle but different construction of alveograph and extensograph analysers.
- It is suitable to be determined the analyser type in baking using, too.
- According to these standpoints the Pannon Premium and Pannon Standard quality criteria system were launched with the important parameters of alveographical W, P/L and the extensographical energy values in 135. relaxing time.

At present there is no limit either in the Hungarian (MSZ 6383/1998. Búza) or the foreign standard of extensographical parameters, moreover, the Hungarian standard has no alveographical limits. The baking limits with costumer's claims can promote correction of quality requirement in Hungarian Wheat Standard and it can give useful information for laboratories and wheat flour market (bakery, mill, traders).

7. LIST OF PUBLICATIONS ASSOCIATED WITH THE TOPIC OF THE THESIS

Lectures

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