

CHARACTERIZATION OF WHEAT VARIETIES AND RELATIONSHIPS BETWEEN TECHNOLOGICAL INDICES

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Summary

Ten varieties of wheat, four hard and six soft have been studied. The technological indices and the correlation coefficients have been determined. According to the results, the varieties differ as follow:

- Good technological quality.
- Good milling properties and bad bread making properties.
- Bad milling properties and good bread making properties.

It has been showed that the gluten hydratation is a factor witch permits to distinguish soft and hard wheat. It does not depend of gluten quantity. When it increases the vitreousity decreases.

Using Blackman's criterion, it has been established relationships between vitreousity and bread making properties characterized by gluten levels, hydratation and bread making strength number. The influence of vitreousity on bread making strength number is more important in hard wheat than in soft wheat.

Key-words: Technological indices-characterization-relationship-wheat.

Résumé

Dix variétés de blé, quatre durs et six tendres ont été étudiées. Les indices technologiques et les coefficients de corrélation ont été déterminés. D'après les résultats les variétés se différencient comme suit :

- Bonne qualité technologique.
- Bonne valeur meunière et mauvaise valeur boulangère.
- Mauvaise valeur meunière et bonne valeur boulangère.

Il a été montré que l'hydratation du gluten est un facteur qui permet de distinguer le blé tendre du blé dur. Elle ne dépend pas de la quantité de gluten. Lorsqu'elle augmente la vitrosité diminue.

En utilisant le critère de BLACKMAN, il a été mis en évidence des relations entre la vitrosité et les propriétés boulangères caractérisées par le taux du gluten, l'hydratation et la force du blé. L'influence de la vitrosité sur la force est plus importante dans le blé dur que dans le blé tendre.

Mots-clés : Indices technologiques- caractérisation -relation -blé.

ملخص :

عشرة أنواع من القمح , أربعة صلبة و ستة لينة تمت دراستها. القرائن التكنولوجية و عوامل الارتباط تم تحديدها كذلك. وحسب النتائج فان هذه الأنواع تصنف كما يلي :

- نوعية تكنولوجية جيدة.
- قيمة طحن جيدة و قيمة خبز رديئة.
- قيمة طحن رديئة وقيمة خبز جيدة.

تبين من الدراسة ان اماهة الجلوتان هو عامل يسمح بالتمييز بين القمح الصلب و اللين. انها ليست مرتبطة بكمية الجلوتان كما انه اذا كان لمعان القمح عالي فان الاماهة تكون منخفضة.

باستعمال قانون بلاكمان Blackman وجدت علاقات بين اللمعان و كمية الجلوتان. الاماهة و قوة القمح. ان تأثير اللمعان على قوة القمح و اكبر عند القمح الصلب مقارنة مع القمح اللين.

مفتاح الكلمات: تمييز, قرائن تكنولوجية, علاقات, قمح.

INTRODUCTION

Wheat is the main grain culture that is utilized for the nutrition of mankind. The foodstuffs that are produced from wheat flours, semolina and dust are numerous and their range of variety is great beginning from bread - the main foodstuff and passes through many kinds of bread, confectionary and macaroni products. The requirements of the various productions on the basis of wheat products in some cases are diametrically opposite. For example, the macaroni industry prefers claims for flours having definite size. The qualities of grain and grain products can be explained by the properties expressed in definite quality indices [1, 2, 3, 4, 5, 6,]. The

relationships between the separate quality indices allow us to appreciate more deeply the technological quality of wheat. The objective of this work is to highlight:

The technological characteristics of wheat varieties.

The relationships between various technological indices determining the milling and bread making properties

MATERIAL AND METHODS

Table1. Showing types and origins of the studied wheat varieties.

Varieties	Types	Origins
Sadovo.1.	Soft wheat	Institute of selection Sadovo - Bulgaria
Katia	//	//
Pobeda	//	//
Strampeli	//	I.T.G.C. Algiers, Algeria
Mahon-Demias	//	//
Anza	//	//
Zagorka	Hard wheat	Institute of Hard wheat and Cotton, Tchirpan. Bulgaria.
Guergana	//	I.T.G.C. Algiers, Algeria
Bidi 17	//	//
INRAT 69	//	//

For the determination of the thousand kernels weight, two quantities of 500 kernels are weighed separately and added. It is the thousand kernels weight of the sample which have a defined moisture. If the difference between the weighing does not exceed 3%, the result is accepted. In the contrary case, the experiment is remade [6]. The relation expressing the thousand kernels weight is:

$$X = \frac{T(100-W)}{100}$$

where: X = thousand kernels weight (%) D.M.

T = thousand kernels weight (%) H.M.

W = moisture of kernels (%)

The hectoliter weight is the weight in Kg of 100 dm³ wheat having moisture equal to 13%. All impurities are eliminated. In the present method, the weight of kernels occupying a volume of 200cm³ is determined. The result is brought back to the quantity in Kg per 100 dm³. A correction according to the moisture of the sample used has been carried out. For each difference between the moistures equal to 1%, 0.3Kg has been subtracted [6].

Concerning gluten 23-25g of ground wheat is placed in metal container. It is added 13-15 cm³ of water. With spatula it is proceeding to the formation of dough. The latter is then mixed with three fingers of hand. The time of mixing is 3 minutes. A ball form is given to the obtained product that is purged in a cup containing water at 20±1°C during 20 minutes. The washing is realized on a sieve to avoid any waste. Such an operation is done attentively at the beginning. Washing has been carried out in an energetic manner when most starch and the other existing components were eliminated, and gluten is formed. The flow rate of water is 500-700cm³/min. The complete process does not last less than 10 minutes. Gluten weighting is done once gluten begins to stick weakly on the hand. Gluten is then washed for 2-3 minutes and weighed again. If the difference between the 2 masses is less or equal to 0.1g washing is finished [7]. The quantity of humid gluten is calculated according to the following equation:

$$Q.H.G = 4 m$$

Where: Q.H.G = Quantity of Humid Gluten (%).

m = Mass of gluten (g)

4 = Constant value.

The difference between 2 essays must be ±2%.

At washing gluten it is weighted 4±0.02 g. A ball is formed from the obtained product before being placed on glass plate. The latter is laid on a millimeter paper. Both vertical and perpendicular diameters are measured. The arithmetic mean value between the found values refers to the initial diameter. The plate is placed at 30°C during 60

minutes. After such, it is proceeded in the same way for the determination of the final diameter [7]. The gluten slackening is given by:

$$G.S = D_{fo} - D_o$$

Where: G.S = Gluten Slackening (mm).

D_{fo} = Final diameter (mm).

D_o = Initial diameter (mm).

The others technological indices have been done by classical methods. The samples have been ground using a Chopper (type OC-106) - Hungary. The maximum particle size was 400µm. The correlation ratio *h_{yx}* is determined by using the equation:

$$h_{yx} = \frac{\sum f_x (y_x - \bar{y})}{\sum f_y (y_i - \bar{y})^2}$$

where: $\bar{y}$ = general arithmetical means

y_x = group arithmetical means

f_y = frequency of the y row

f_x = frequency of the x row

The authenticity of the correlation ratio and the correlation coefficient has been checked at $\alpha = 0.05$ and $\alpha = 0.01$ after the criterions of Fisher and student [8]. Relationships determination has been made by regression analysis, where the form of the relationship has been made according to Blackman's criterion [8].

RESULTS AND INTERPRETATION

Table 2. gives the results obtained for the various investigated indices determining the wheat milling properties. Six repetitions each have been carried out them. Results have shown that the thousand kernels weight, hectoliter weight, vitreousity and ash content can not serve as an indices for discerning soft and hard wheat.

Table 3. gives the results obtained for the various indices investigated determining the wheat bread making properties:

Humid gluten yield, dry gluten yield, hydration, gluten quality (gluten slackening) and bread making strength number. The Gluten yield is as higher as the hydration. From the results it can be seen also that two varieties with different dry gluten yield can have one and the same hydration, while two varieties with one and same gluten yield have different hydration (gluten yield (%) / hydration (%)). Anza 20.30 (%) / 198.22 (%). Pobeda 34.63 (%) / 198.5 (%). Mahon-Demias - 25.06 (%) / 203.38 (%) and adovo 1.32.85 (%) / 202.5 (%). Strampeli 32.4 (%) / 208 (%). INRAT 69.21.18 (%) / 180.74 (%) and Gergana 22.48 (%) / 170.05 (%). The gluten hydration discerns soft wheat from hard. It can be

that two varieties with very different gluten yield have one and the same gluten quality (gluten slackening). Two varieties with equal gluten yield have one and the same slackening (Humid Gluten Yields (%) / Gluten - slackening (mm)) ANZA 20.30 % / 8.25 mm. Sadovo 1. 32.85 % / 8.56 mm. Mahon-Demias 25.06 % / 12.08 mm. Pobeda 34.63 % / 11.19 mm. Strampeli 32.46 % / 7.66 mm and Katia 33.46% / 7.83 mm. On this basis it can be stated, taken separately, gluten yield and gluten slackening characterize to an insufficient degree wheat quality. From the investigation, it can be seen that one variety can have good milling and bread making properties but there can be a variety having good milling but not good bread making properties and vice versa.

The data related to the relationship between some technological indices determining the milling and bread making properties of wheat are shown on table4. The values of the correlation ratio show that there is not relation between vitreousity and hectoliter weight. The same concerns both indices-hydration and gluten slackening determining the bread making properties of wheat. The remaining relations indicated have a correlation ratio significant at $\alpha = 0.05$ and $\alpha = 0.01$. The coefficient of correlation concerning the relationships between vitreousity and humid gluten content is $R=0.22$. At the basis of correlation ratio and the coefficient of correlation it can be concluded that the relationship is of a non-linear type. For the relationship between dry gluten content and that of humid gluten, the coefficient of correlation is $R= 0.97^{**}$. This shows that both indices are highly correlated. The relationships established is of linear type. Figure1. shows the regression line, regression equation and the coefficient of correlation. For the relationship between gluten hydration and dry gluten content. The coefficient of correlation is $R =0.22$. It shows that gluten hydration does not depend on its quality. The coefficient of correlation for hydration and vitreousity is $R = - 0.60^{**}$. The vitreousity influences on gluten hydration. Figure 2 shows the curve, the equation and the error. When the vitreousity decreases the hydration increases. The

coefficient of correlation concerning the relationship between vitreousity and wheat strength presented by means of bread making strength number is $R = 0.37^{*}$. Figure3. shows the regression line, regression equation and the coefficient of correlation.

Table5. shows the regression equations and the correlation coefficients for the relationships between: (Humid. Gluten. Yield-Dry. Gluten. Yield). (Vitreousity-Bread making Strength. Number). For soft and hard wheat, the coefficients of correlation for the relationships between the humid gluten yield and the dry gluten yield are $R =0.99^{**}$. The slopes of the regression equations are practically identical. For the relationships concerning the vitreousity and bread making strength number, the coefficients of correlation for soft and hard wheat are respectively $R = 0.49^{*}$ and $R = 0.79^{**}$. The results show that the correlation between both indices is higher in hard wheat than in soft. The slopes of the regression equations for soft and hard wheat are respectively 0.37and 0.85. If for the first case, the slope is significant at $\alpha = 0.05$, for the second case it is significant at $\alpha = 0.01$. This shows that the effect of vitreousity on bread making strength number differs depending on the type of wheat. The effect of vitreousity on the bread making strength number is from 2 to 3 times higher in hard than in soft wheat.

CONCLUSION

One variety can have good milling and bread making properties. There can be a variety having good milling but not good bread making properties and vice versa. The gluten hydration is greater in soft wheat than in hard one and does not depend on its quantity. An inverse proportion dependence exist between gluten hydration and wheat vitreousity. The effect of the vitreousity on wheat bread making strength number is stronger expressed with hard wheat ($R=0.79^{*}$) than with soft ones ($R=0.49^{*}$)

Table 2:Indices investigated for the various varieties determining the milling properties

Varieties Indices	Sadovo	Katia	Pobeda	Strampeli	Anza	M. Demias	Zagorka	Gergana	Bidi 17	INRAT 69
Moisture (%)	11.52	10.69	11.46	9.05	9.48	10.56	10.00	11.41	9.70	9.86
Thousand Kernels Weight, (g)	45.35	37.79	41.30	34.78	40.90	46.54	44.04	51.04	41.11	43.30
Hectoliter Weight (kg/100 dm ³)	81.74	79.79	79.79	82.57	83.91	78.80	82.45	80.79	80.20	75.21
Vitreousity (%)	58.16	56.83	55.16	44.50	48.33	21.50	80.91	62.66	82.16	52.50
Ash content (%)D.M	1.67	1.52	1.52	1.97	1.97	1.77	1.54	1.51	1.99	2.10

Table 3. Investigated indices for the various varieties determining the bread making properties

varieties	Sadov o 1	Katia	Pobed a	Stramp eli	Anza	M. Demias	Zagork a	Gergana	Bidi 17	INRAT 69
Indices										
Humid Gluten Yield (%)	32,85	33,46	34,63	32,40	20,30	25,06	25,71	22,48	33,48	21,18
Dry Gluten Yield (%)	0,24	10,92	1,48	10,44	6,75	8,15	9,25	8,04	11,47	7,53
Gluten Hydratation (%)	202,15	195,47	198,2 5	208,00	198,2 2	203,38	175,79	170,05	191,38	180,74
Gluten Slackening (mm)	8,58	7,83	11,91	7,66	8,25	12,08	9,91	9,75	6,41	11,38
Bread making Strength Number (Condlunits)	63,00	65,75	53,00	67,75	44,25	45,50	50,25	45,25	77,00	40,50

Table 4. Relationships between some investigated technological indices.

variables		correlation ratio		coefficient of correlation		statistics		type of relation	
X	Y	h _{yx}	h' _{yx}	R	R²	B	Bk		
Vitreosity	Hectoliter Weight	0,36							
Vitreosity	HGY	0,76**	0,57	0,22	0,05	30,68	11,37		
hydratation	Vitreosity	0,79**	0,62	-0,60**	0,36	15,34	11,37		non-linear
HGY	DGY	0,99**	0,98	-0,97**	0,94	3,56	11,37		linear
Hydratation	DGY	0,52**	0,27	0,22	0,05	25,52	11,37		non-linear
Hydratation	Gluten Slackening	0,28							
Vitreosity	BSN	0,63**	0,39	0,37*	0,13	10,40	11,37		linear

Remark:

HGY = Humid Gluten Yield
DGY = Dry Gluten Yield
BSN=BreadmakingStrengthNumbe

* Significant at $\alpha = 0,05$
** Significant at $\alpha = 0,01$

DRY GLUTEN (%)

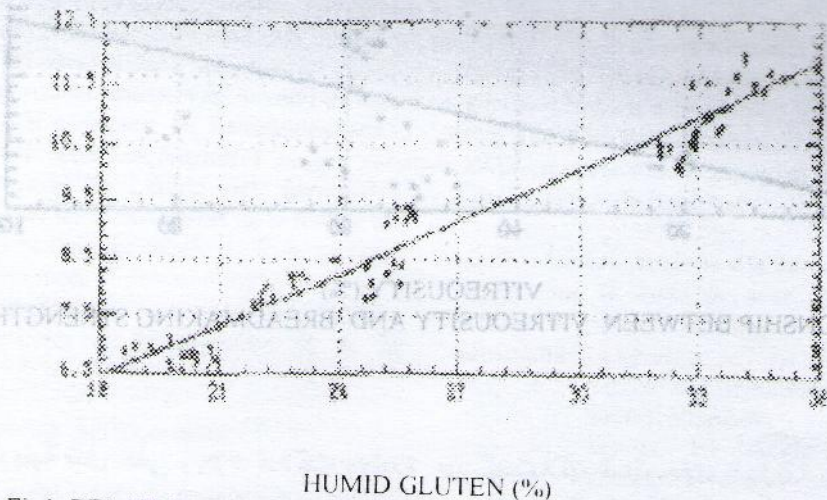


Fig1. RELATIONSHIP BETWEEN DRY GLUTEN AND HUMID GLUTEN

VITREOUSITY (%)

$$Y = \exp(7.04 - 0.01x)$$
$$E = 0,30$$

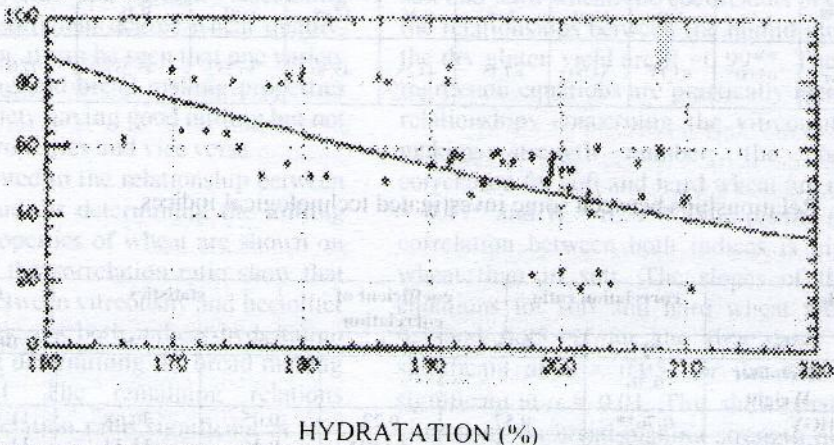


Fig.2. RELATIONSHIP BETWEEN GLUTEN HYDRATATION AND VITREOSITY.

BREADMAKING STRENGTH NUMBER. (Cond. Units)

$$Y = 0,26X + 40,47$$
$$R = 0,37$$

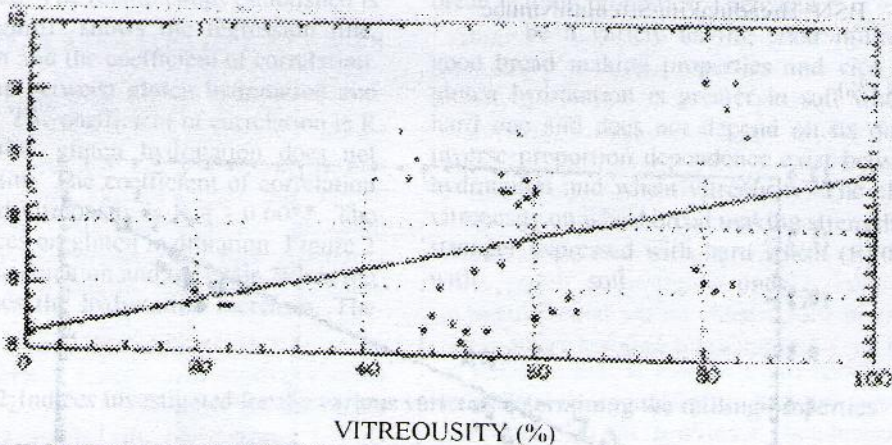


Fig3. RELATIONSHIP BETWEEN VITREOSITY AND BREADMAKING STRENGTH NUMBER

Table.5. Relationships between technological indices in hard and soft wheat

Variables		Species	Correlation coefficients	Regression Equations
X	Y			
A. Humid Gluten (%)	Dry	Soft wheat	R = 0,99**	Y = 0,31 x + 0,29
	Gluten (%)	Hard wheat	R = 0,99**	Y = 0,33 x + 0,62
Vitricosity (%)	Bread making Strength	Soft wheat	R = 0,49*	Y = 0,37 x + 38,46
	Number (cond.units)	Hard wheat	R = 0,79**	Y = 0,85 x - 6,40

* Significant at $\alpha = 0,05$
** Significant at $\alpha = 0,01$

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