

RESEARCH CONCERNING THE MECHANICAL PROPERTIES FOR SOME OF THE VARIETIES OF WINE GRAPES

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Abstract: *The paper presents some experimental results obtained during the study of the mechanical properties of some wine grape-varieties cultivated in Romania.*

The variation of the detaching force of the grapes from the peduncle and the crushing force of the grapes are detailed as a function of the maturation degree, the grape mass, the detaching angle, the relative compression and the elasticity modulus of the grapes.

Keywords: *Detaching Force, Sugar Content, Crushing Force.*

INTRODUCTION

World research on bunch and grape detaching, during mechanized harvesting processing of wine grape-varieties, revealed the fact that it depends on several factors. In the case of harvesting by horizontal shaking, these factors proved to depend both on the culture characteristics and the features of the harvesting machine.

The former comprises, among other things, the variety of cultivated soil, the cutting and guidance type of the vine and the physical-mechanical properties of the grapes. The most important elements of the latter are the construction of the shaking equipment and its tuning capacity of shaking frequency and amplitude.

Physical parameters such as mass, density, volume, consistence, are easily determined. In order to select the appropriate working regime, at the mechanized harvesting by shaking, the mechanical characteristics of grapes are necessary. Thus, in order to select the appropriate shaking frequency, parameters such as grape detaching and crushing forces are to be known while for grape transport the elasticity modulus and the fundamental-oscillation frequency of the grapes are essential.

EXPERIMENTAL MATERIAL AND METHOD

The study was performed on five wine grape-varieties, specific to some vineyards from East Romania: Galbenă de Odobești, Grasă de Cotnari, Șarba, Busuioacă de Bohotin and Chasselas dore, the later being considered both as a wine and a lunch variety.

The research aimed to determine both tensile and compressive forces. Tensile forces, necessary to break the fibrovascular bonds between grape and peduncle, were determined as a function of sugar content, grape mass, and the angle between the applied force and the longitudinal axis of the grape. Compressive forces that cause peel cracking were also determined as a function of sugar content and grape mass.

In order to determine relative compression and elasticity modulus compression tests were performed [1].

The experimental tests and measurements were accomplished by means of specially conceived laboratory devices [2].

EXPERIMENTAL RESULTS

The maturation degree of the grapes, expressed by the sugar content (in g/l) of must, is the most important parameter for the selection of the moment for harvesting beginning.

Experimental measurements of detaching force variation, as a function of the sugar content of the grapes, were performed for an average value of grape mass and a detaching angle of 0^0 , the results being shown in Fig.1.

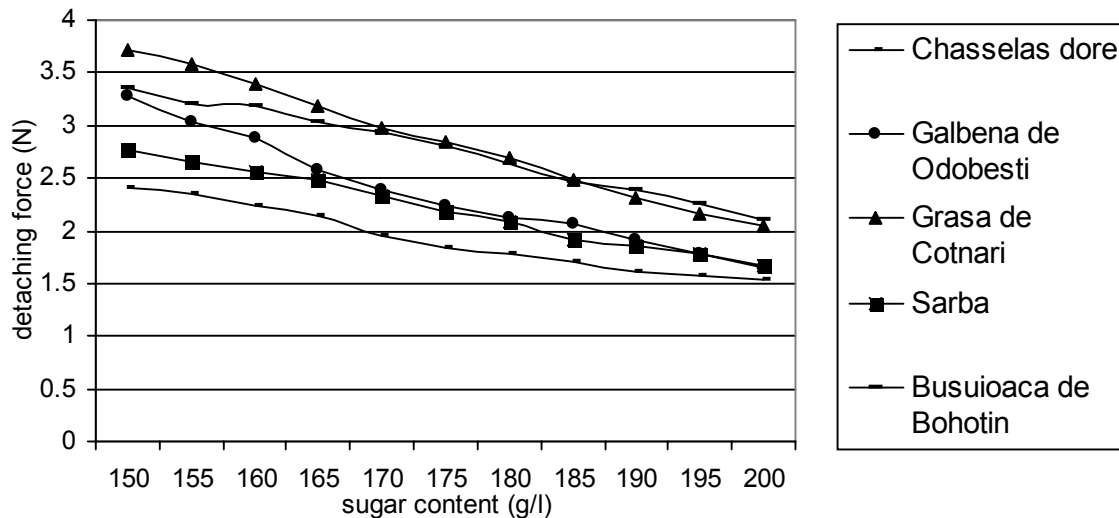


Fig. 1. Variation of detaching force of grapes with sugar content

The analysed results show that, for all the grape varieties under study, the detaching force of the grapes decreases parabolically with the increase of sugar content. At maturity, the detaching force varies between 1.54 N at Chasselas dore and 2.11 N Busuioaca de Bohotin, values that range these varieties within the group of medium detaching force, At supermaturation, detaching force diminishes below 1.4 N (ranging within the group of grape varieties with low detaching force) excepting for the varieties Grasa de Cotnari and Busuioacă de Bohotin, which maintain their elevated values.

The experimental tests, concerning the influence of the angle between the applied force and the longitudinal axis of the grape (detaching angle) on the magnitude of the detaching force, were performed for grapes with average mass and sugar content between 195-200 g/l. The results are summarized in Fig.2.

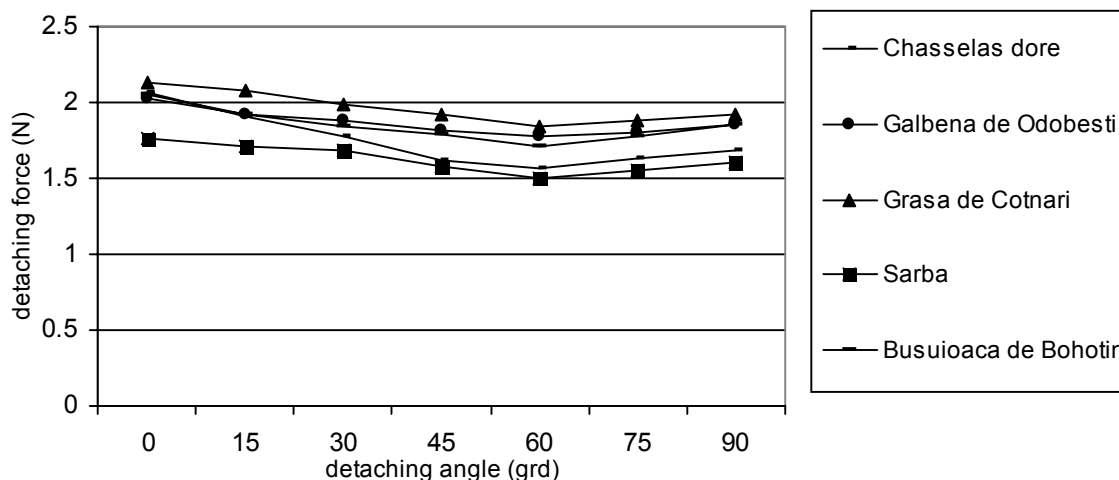


Fig. 2. Influence of the detaching angle on the detaching force of the grapes

It is noticeable that the minimum value of the detaching force is characterized by an approximate angle of 60° . However the experiments have shown that, for angle larger than 35° , in most of the cases and larger than 50° , in all cases, the crushing of grape peel occurs, into the detaching area, which releases larger or lower must amounts, as a function of the cultivated grape variety.

Regarding the influence of grape mass upon the detaching force, it has been revealed that it increases linearly with the mass (Table 1) however, as a consequence of the marked nonuniformity degree of grapes detaching force varies within large limits.

Table 1

Variation of detaching force with the mass of grapes, N

Grape variety	Grape mass (g)						
	1.9-2.2	2.3-2.6	2.7-3.0	3.1-3.4	3.5-4.0	4.1-4.5	4.5-5.0
Chasselas dore	-	1.33	1.65	1.87	2.16	2.33	-
Galbena de Odobesti	1.27	1.45	1.59	1.72	1.80	1.94	-
Grasa de Cotnari	-	1.84	1.99	2.10	2.26	2.49	2.70
Sarba	1.50	1.64	1.72	1.96	2.10	2.29	-
Busuioaca de Bohotin	1.65	1.78	1.99	2.08	2.23	-	-

At the study of crushing force, all measurements were performed on grapes with peduncles on the longitudinal axis of which the compressive force acts.

The crushing force decreases with the increase of sugar content (Fig.3), decrease that also proceeds at supermaturation.

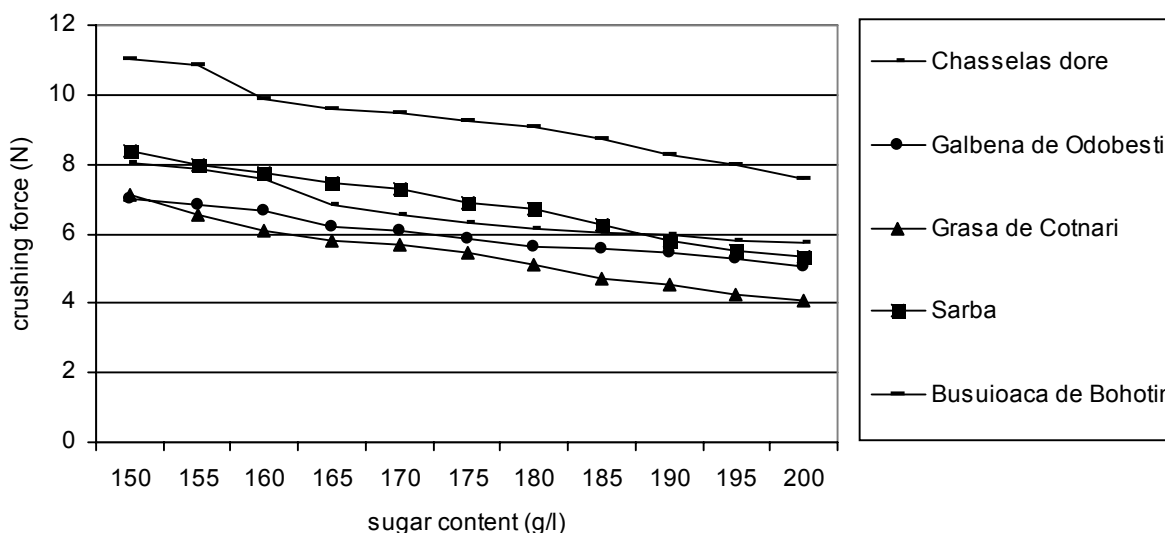


Fig. 3. Variation of crushing force of the grapes with sugar content

Table 2 shows that crushing force, determined under the same conditions as detaching force, increases with grape mass and has the same large variation limits.

Table 2

Variation of crushing force with the mass of grapes, N

Grape variety	Grape mass (g)						
	1.9-2.2	2.3-2.6	2.7-3.0	3.1-3.4	3.5-4.0	4.1-4.5	4.5-5.0
Chasselas dore	-	4.43	4.88	5.29	5.83	6.21	-
Galbena de Odobesti	4.76	4.92	5.07	5.13	5.30	5.58	-
Grasa de Cotnari	-	3.72	3.86	4.01	4.18	4.36	4.57
Sarba	4.56	4.75	4.99	5.14	5.56	5.95	-
Busuioaca de Bohotin	6.89	7.07	7.33	7.50	7.76	-	-

Other characteristics, such as volumetric mass ρ , average radius of grains R , maximum deformation δ , relative compression ε and elasticity modulus E are given in Table 3 for grapes with average mass and sugar content ranging between 195-200 g/l.

Table 2

Values of volumetric mass, ρ , average radius of grains, R , maximum deformation, δ , relative compression, ε and elasticity modulus, E

Grape variety	ρ (kg/m ³)	R (mm)	δ (mm)	ε	E (N/mm ²)
Chasselas dore	1078	9.18	7.24	0.663	0.121
Galbena de Odobesti	1143	8.74	7.30	0.583	0.120
Grasa de Cotnari	1081	9.59	7.92	0.548	0.091
Sarba	1053	8.64	7.10	0.606	0.101
Busuioaca de Bohotin	1083	8.30	5.42	0.674	0.260

From the above experimental data, it was noticed that grape deformation magnitude also depends on grape variety and increases with maturation degree. However it shows an obvious decrease while passing to supermaturation.

CONCLUSIONS

The physical-mechanical properties of grapes are characteristic for each grape variety under study and depend on biological features.

Both detaching force and crushing force decrease with maturation degree and increase with grape mass. A specific influence on detaching force was observed in the case of detaching angle which, at values of 60⁰, causes detaching force decreases lower with 20-25 % as compared to the values recorded at 0⁰ detaching angle

It's worth to mention the fact that the presented data are only valid under normal or close to normal climate conditions. If negative phenomena occur during maturation (eg. exceeding pluviometric regime, frost, etc.) all the parameters drastically decrease to values that can be up to 30 % lower than normal ones.

REFERENCES

- [1] O'Brien, M. et al., 1983, Principles and Practices for Harvesting and Handling Fruits and Nuts, AVI Publishing Company Inc., Westport Connecticut, USA.
 [2] Băisan, I. and Damian, D., 1997, Research concerning mechanical properties of grapes from Chasselas dore variety (in Romanian), The Agronomic University from Iași, vol. 40, 362-365.

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