Biblid: 0350-2953 (2014) 40(1): 1-8 Originalni naučni rad
UDK: 663.032:634.8 Original scientific paper

VERIFICATION OF THE EFFECTIVENESS OF PLANAR VIBRATING SEPARATOR DURING SEPARATION OF GRAPEVINE SEEDS FOR OIL PRESSING
OCENJIVANJE EFIKASNOSTI RAVNOG VIBRACIONOG SEPARATORA TOKOM ODVAJANJA KOŠTICE GROŽĐA ZA CEĐENJE ULJA

Burg P[1], Ludín D[1], Turan J[2]
[1]Department of Horticultural machinery, Faculty of Horticulture, Mendel university in Brno, Valtická 337, 691 44 Lednice, Czech Republic,
[2]University of Novi Sad, Faculty of Agriculture, Department of Agricultural Engeneering, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia
e-mail: patrik.burg@seznam.cz

Abstract
The paper deals with the evaluation of the separation efficiency on planar vibrating separator and the purity of the separated seeds from marc of selected grape varieties. Measurements were made in 2013 for the varieties as follows: Traminer, Sauvignon, Riesling, Grüner Veltliner, Riesling, André, Lemberger, Cabernet sauvignon, Cabernet Moravia, Zweigeltrebe. Total weight of the collected samples was 70 kg. From the results obtained it is evident that all of the observed separation efficiency varieties is high and varies between 63–83%. The lowest seed yield was found in Sauvignon (13,9%) and Riesling (15,9%), the highest in the variety André (33,7%). Purity of the separated seeds in most samples was relatively stable (76–90%).
Key words: winery, grape marc, grapevine seeds, separator, oil from the grapevine seeds

Introduction

In the European wine operations, there is 8 million tonnes of grape marc processed annually. As the statistical data shows, it is clear that in the Czech Republic there is processed about 60.000 tons of grapes in the major wine-producing plants every year, which equals to18.000 tons of grape marc.

EU Legislation and the ever stricter national regulations in the waste management sector, strive for waste-free technologies that ensure effective and efficient use of waste products from manufacturing processes , Boulton, Butzke (1995) . In terms of waste management the wine marc is a secondary biotic waste belonging in the Food- Drink-Milk sector, which can not be disposed at municipal waste landfills , Environment Protection Authority (2001).

The marc is made up of seeds, scraps and fragments of stem and peels of the processed grapes. The portion of seeds in the marc is usually 14–30%, residues and fragments of stem represent 8–10% and the rest are skins of pressed grapes, Schieber et al. (2002). Eg. Gaspar and Mark (2008) report that marc by Cabernet Sauvignon contains 5% seeds, 15% husks and 80% pulp.

The seeds present an interesting opportunity for further usage. Thus Numerous authors such as Skelton (2000); Dědina (2010); Marshall, *et al.* (2012) recently deal with the issue of seeds separation. The separation efficiency is also subject to an average size of seeds. This issue is dealth with by such authors as Razavi and Fathi (2009). The results of the analysis show that the average seeds length of the ranges between 7.74 to 8.28 mm, and its width from 4.26 to 4.50 mm.

However, these efforts are still limited by technical possibilities to build a production line for seed separation, drying and oil pressing. This is also due to the fact that the technical solution of seeds separation and related technological oil production lines proposals has not yet been addressed in the CR.

Seeds separation can be used for oil extraction. Grape seed contains about 12–16 % oil, Bravi *et al*. (2007); Martinello *et al.* (2007). Grape oil is currently highly prized raw material mainly for its beneficial nutrients. It has a high content of essential fatty acids and tetraphenols, Anastasiadi, Pratsinis *et al.* (2010). Major constituents are tannins (3–6%) and oil (10–20 %). There are also other soluble components such as sugars , acids, proteins, and a relatively high contents of ash. The oil also contains large amounts of antioxidants and vitamins , Yamakoshi *et al.* (2002). It also shows that the consumption of grape oil can be used as an high cholesterol treatment (Baydar, 2001).

The experimental measurements was to verify the effectiveness of the separation plane vibrating screens and purity of the separated seeds from marc of selected grape varieties for their use in oil extraction.

MATERIAL AND METHODS

Marc varieties evaluated

Marc samples were taken immediately after the pressing. The pressing was held continuously in the processing season 2013. In any case the compaction pressure did not exceed the value of 1.8 bar. A total of 10 marc samples were taken; the wine varieties as follows - Traminer, Sauvignon, Riesling, Grüner Veltliner, Welschriesling, André, Lemberger, Cabernet sauvignon, Cabernet Moravia, Zweigeltrebe. Weight samples was 70 kg.

Equipment for the separation

For the purpose of experimental measurements a vibratory separator prototype developed at the Institute of Horticultural Machinery, Faculty of Horticulture, Mendel University in Brno was used. This device applies the principle of mechanical vibrations transmitted to a trio of flat screens with different shapes and sizes of holes and is designed in a mobile version. The base is solid steel frame with single-axle wheeled chassis and suspension . The supporting frame is mounted via silent blocks removable superstructure with three interchangeable flat screens. In the first separation stage marc consisting of large particle agglomerates husk size greater than 10 mm are separated. The second separation step peel cores of a size greater than 5 mm are separated. The third screen is only used for clearing wine cores from small particles of grape marc. Vibrating motion is ensured by a three-phase electric motor with an output of 2.1 kW. The average performance of the separator is 100 kg of seeds per hour.

Fig. 1: The separator with planar vibrating sieves

Figure 2: The separated seeds vine

Determination of yield and seed purity in separation

The researched samples of marc were weighed (weight 70 kg) before separating. After the processing the separated seeds were weighed. Separation efficiency was then expressed relative to 100% efficacy (main sample). The proportion of seeds and husks in the main sample of marc weighing 2000 g was evaluated in the both evaluated varieties set on vibration analysis laboratory sieves with a diameter of 6–2 mm mesh.

From the seeds of the separated on a vibrating separator, in order to determine the purity of the collected composite samples, which were then manually separated and weighed on an analytical balance. An unit was set to be equal to the weight of thousand seeds. After being dryed out a gravimetric moisture content mesurement was carried out.

Methods of statistical evaluation

To evaluate the resulting values measured in the separation of seeds from grape marc available statistical indicators and methods were used, such as arithmetic means, standard deviations, method of construction of confidence intervals around the arithmetic mean and variance analysis. As a method of subsequent testing was used Tukey HSD test at significance level α=0.05. These statistical evaluation methods were applied by using PC software Microsoft Excel and Statistics 10 CZ.

RESULTS AND DISCUSSION

The line separator works on a principle as follows: the smooth sliding motion of marc layers on the flat surface of the screen , ensures that the seeds fall through the sieve holes of calibrated size. To ensure movement of the sieve material has been tilted by 10^0 and supplemented by the vibrating motion. Greater sloping contributes to the more rapid shifting of the raw materials and channel congestion, drainage oversize fraction, or overflow of raw materials over the edge of the screen. When a lesser sloping is set, then on the contrary, raw materials move very slowly , the desktop screen forms thick raw material layer and reduces the efficiency of the entire device.

Marc separated from the press is conveyed to the area of the highest sieve screen, with holes of the largest size. When moved over the surface, the marc mesh leads to gross

before separation of seeds which are further cleared of its skins. Seed itself with residues of small impurities to fall through the central area of the screen with smaller openings, where they are further polished, which is completed on the surface of the final sieve with the smallest openings. Undersize fraction consists of mechanicaly damaged or not fully developed seeds or fine fragments of skins that have no importance for further use.

Tab. 1 – Overview of the monitored variables

Samples of marc		The average value of monitored variable				
Varieties	Input weight of marc (kg)	Weight of seeds by 100 % efficacy of separation (kg)	Weight of the separated seeds (kg)	Moisture of seeds (%)	Thousand grain weight (g)	Separation efficiency (%)
Zweigeltrebe	70.00	35.99	22.83	66.28	39.00	63.43
Cabernet Sauvignon	70.00	20.57	13.95	65.53	39.00	67.82
Cabernet Moravia	70.00	24,68	17.76	61.08	48.00	71.98
Riesling	70.00	14.58	11.17	72.27	37.00	76.57
Welschriesling	70.00	19.55	15.41	65.83	33.00	78.83
Traminer	70.00	15.81	12.61	66.28	36.00	79.76
Sauvignon	70.00	11,95	9.73	69.68	42.00	81.48
Lemberger	70.00	22.07	18.14	64.24	34.00	82.21
André	70.00	28.44	23.63	60.06	34.00	83.08
Grüner Veltliner	70.00	15.03	12.59	67.21	46.00	83.75

From the results obtained it is evident that all of the observed separation efficiency varieties is high and varies according to the variety between 63–83%. The course of the process will be mainly affected by the degree of sifting network load (layer thickness), the mixture composition, mechanical and physical properties of separated materials and kinetics of movement network.

Marc analysis and separation of nuclei in the CR is for example dealt by Plíva (1999), who conducted laboratory sieve marc analysis. Used in sow diameter mesh 2.0, 3.5 and 5.0 mm, however after the separation dried marc containing the dried grape pips was used. Separation efficiency achieved was around 55–70%. Abroad (Australia), the issue of separation of seeds from marc fresh is dealt with by Marshall *et al.* (2012). The prototype of the rotating cylindrical separator reached up to round 75% of the separation efficiency.

Figure 1 and Table 2 shows the results of the statistical evaluation of the measured weight of seeds (seed yield) of the separated weighed marc samples of different varieties.

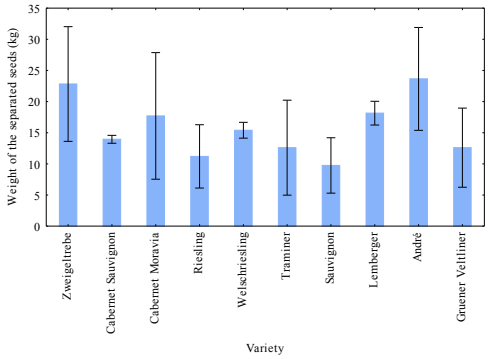

Fig. 1 – The significance differences verification between weight of seeds in evaluated varieties with confidence intervals

The results of the varaince analysis (ANOVA) showed the significant differences in evaluated varieties in the separated quantity of seeds. Table 2 shows the results then Tukey HSD test - a homogeneous group, which shows the significant differences obtained by comparing the yield of different varieties of seeds. For varieties such as Riesling, Grüner Veltliner, Gewurztraminer and Cabernet Sauvignon, there are no statistical significance in seed yield.

Tab. 2: Method of sequent testing–Tukey HSD (compare according by variety, significant difference at 0,05 significance level)

Group	Variety	Mean (kg)	1	2	3	4	5
7	Sauvignon	9,750				****	
4	Riesling	11,200	****			****	
10	Grüner Veltliner	12,600	****	****			
6	Traminer	12,600	****	****			
2	Cabernet Sauvignon	13,950	****	****			
5	Welschriesling	15,400		****	****		
3	Cabernet Moravia	17,700			****		
8	Lemberger	18,150			****		
1	Zweigeltrebe	22,825					****

On the contrary, the most significant difference ($\alpha = 0.05$) in terms of seeds extracting yield were found in Sauvignon (lowest value achieved - 9.75 kg) and Zweigeltrebe (highest value - 22.825 kg). Overall, a higher yield of seeds was found in red varieties is therefore affected grape processing technology in the production of red wines , the skins during fermentation leads to partial decomposition of the skin, while releasing the seeds . Furthermore, it is fundamentally influenced by varietal characteristics. The issue of assessing the number of seeds in the berries and their average weight is dealt with by Hofacker (2004). The results of the analysis show that the number of seeds in individual grape varieties ranges from 1–6, on average there are 2 seeds in each berry. The average weight of seeds in white varieties such as Riesling, Sylvaner ranges from 21 to 27 mg, while for red varieties such as Blue Portugal and Alicante blue weight is much higher and reaches 70–93 mg. Also Chadha and Randawa (1974) states that the morphological

characters of seeds in vines are varietal characteristics dependant. Hardie and Aggenbach (1996) reported that the number of seeds in the berries and their weight depends on habitat conditions, year and growing technology. From the results of the monitored samples can be indicated that the length of the seeds is between 3–7 mm, width 3–5 mm.

In terms of separation efficiency there are also acceptable losses of seeds that were not separated during separation from the marc and is thrown away in oversize fraction. According to Marshall *et al.* (2012) a major loss is represented by seeds that remain after being firmly pressed and locked inside the husk, or are bound to their skin surface by adhesion forces. Values around 20–30% can be considered as an acceptable loss.

Chart 2 shows the percentages expressing the purity of the separated seeds that were in the majority of samples were relatively stable (76–90%). Providing a high degree of seed purity is significant in terms of further seed pressing.

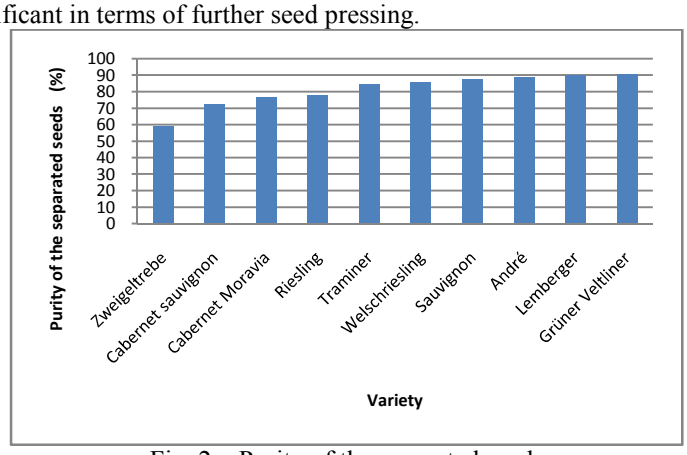

Fig. 2 – Purity of the separated seeds

Dědina et al. (2013) reported that the viability of seeds during oil extraction can be actively influenced by their purity. For this reason prior to pressing it is important to clean seeds of dirt particles small husks debris , immature kernels etc. These fine particles may constitute up to 20% of the total volume of the mechanically separated seeds and cause clogging of the compression head . Also Nerantzis and Tataridis (2006) emphasize the low proportion of impurities in the seeds of the vine during pressing. The proportion of these impurities can be significantly reduced by using pneumatic or centrifugal separators. According Rotkiewicz et al. (1999) over the past few years , the interest in herbal cold-pressed oils has risen because these oils have better nutritional properties than those being refined. Cold pressing is simple, environment-friendly and does not require much energy. The disadvantage of this method is the low productivity , difficulty in obtaining a product of constant quality , and last but not least an adequate product purity is required.

CONCLUSION

In Europe, there are an increasingly reflected efforts to use technology to significantly reduce the production of waste and thus the cost of disposal. In the field of grape processing and wine production both medium and large wine operations are looking for new ways to use residual products such as grape marc. Besides composting grape marc,

same as in higly developed wine making countries, we seek to cope with marc processing technology for the production of oil from the seeds of grapes.

However, these efforts are still confronted with limited technical possibilities to build a production line for separation, drying and pressing oil from seeds. This is due to the fact that the issue of technical solutions of separation seed separation and related proposals technological lines for the production of oil from the seeds of the vine has not yet been addressed in the CR.

The paper presents the results of the separation vine seeds of 10 different samples of grape marc , which were carried out on a prototype vibrating screens developed in partnership with the Institute of Horticultural Machinery Mendel University in Brno and Prague VÚZT. The results indicate that the separation efficiency of this unit ranges between 63–83%, while ensuring high purity of seeds, which meets the high demands for further processing.

LITERATURE

[1] Anastasiadi, M., Pratsinis, H., Kletsas, D., Skaltsounis, A-L., 2010: Bioactive non-coloured polyphenols content of grapes, wines and vinification by-products: Evaluation of the antioxiadant activities of their extracts. Food Research International, 43: 805–810.

[2] Baydar, N. G., Özkan, G., Çetin, E. S., 2007: Characterization of grape seed and pomace oil extracts. Grasasy aceites, 58: 29–33.

[3] Baydar, N. G., Akkurt, M., 2001: Oil Content and Oil Quality Properties of Some Grape Seeds, Turkish Journal of Agriculture and Forestry, vol.25,iss.3., 163-168.

[4] Beaedsell, D. , Francis, J., Ridley, D., 2002: Health promoting constituents in plant derived edible oils.

[5] Boulton, B. R., Butzke, CH. E., 1995: Tartrate recycling: a combined approach to by-product recovery and waste reduction', Department of Viticulture and Enology, University of California, December 1995.

[6] Bravi, M. et al., 2007: Improving the extraction of α-tocopherol-enriched oil from grape seed by supercritical CO_2, optimization of the extraction conditions. Journal Food Eng. 78:488-493.

[7] Burg, P., Zemánek, P., Jelínek, A., Dědina, M., Skala, O., 2013: Separace semen révy vinné z matolin. Uplatněná certifikovaná metodika. Brno: MENDELU v Brně, Ediční středisko. 26 s. 1. vyd. ISBN 978-80-7375-925-4.

[8] Chadha, K. L.; Randawa, G. S., 1974: Characters used in grapes description and classification. In: Nair, K.B., Grape Varieties in India. U.S. JAin, New Delhi, 7-41.

[9] Dědina, M., Burg, P., Čejka, Z., Zemánek, P., Jelínek, A., 2012: Dvoustupňový vibrační separátor, FV I - 111B107 – 2012.

[10] Environment Protection Authority, 2001: Consultancy report: Opportunities for the reuse of winery industry solid wastes, SA Waste Management Committee, PPK Environment & Infrastructure Rty Ltd, 17 January 2001.

[11] Gaspar, R., Matthews, M. A., 2008: Relative proportions of seed, skin and flesh, in ripe berries from Cabernet Sauvignon grapevines grown in a vineyard either well irrigated or under water deficit, Australian Journal of Grape and Wine Research, DOI: 10.1111/j.1755-0238.2004.tb00009.x

[12] Hardie, W. J., Aggenbach, S. J., 1996: Effect of site, season and viticultural practices on grape seed development. Australian Journal of Grape and Wine Research, 2:21-24.

[13] Hofäcker, W., 2004: Samenzahl und gewicht von Trauben und ihr Einfluss auf das Beerengewicht. Admedia AG: Schweizer Zeitschrift für Obst- und Weinbau, Nr.16, S. 9 – 12, ISSN 1023-2958.

[14] Marshall, J. CH., Ripper, CH. S., Rombola, R. A., 2012: A separator for separating grape seeds from grape marc waste. Australian patent AU2006252259.

[15] Nerantzis, E. T., Tataridis, P., 2006: Integrated Enology - Utilization of winery by-products into high added value products. e-Journal of Science & Technology. Nr. 3, p. 1–12. ISSN 17905613.

[16] Plíva, P., Jelínek, A., 1999: Vinný olej- žádaná surovina na trhu. Agromagazín, 3/1: 21-23, 1999.

[17] Rotkiewicz, D. , Konopka, I., Ylik, S. 1999 : State of works on the rapeseed oil processing optimalization.

[18] Schieber, A., Müller, D., Röhrig, G., Carle, R., 2002: Effects of grape cultivar and processing on the quality of cold-pressed grape seed oils**.** Mitteilungen Klosterneuburg, 52 (2002), pp. 29–33.

[19] Shrikhande, A. J. et. al., 2003: Process for extraction, purification and enrichment of polyphenolic substances from whole grapes, grape seeds and grape pomace, US6544581 B1.

[20] Yamakoshi, J., Saito, M., Kataoka, S., Tokutake, S., 2002: Procyanidin-rich extract from grape seeds prevents cataract formation in hereditary cataractous (ICR/f) rats, Journal of Agricultural and Food Chemistry, 50 (2002), pp. 4983–4988.

OCENJIVANJE EFIKASNOSTI RAVNOG VIBRACIONOG SEPARATORA TOKOM ODVAJANJA KOŠTICE GROŽĐA ZA CEĐENJE ULJA

Burg P[1], Ludín D[1], Turan J[2]

[1]Department of Horticultural machinery, Faculty of Horticulture, Mendel university in Brno, Valtická 337, 691 44 Lednice, Czech Republic,

[2]University of Novi Sad, Faculty of Agriculture, Department of Agricultural Engeneering, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia

e-mail: patrik.burg@seznam.cz

REZIME

Rad se bavi procenom efikasnosti razdvajanja na ravnom vibracionom separatoru i čistoći izdvojenih semena iz komine od odabranih sorti grožđa. Merenja su realizovana u 2013. godini za sorte Traminer, Sauvignon, Riesling, Grüner Veltliner, Riesling, André, Lemberger, Cabernet sauvignon, Cabernet Moravia, Zweigeltrebe. Težina prikupljeni uzorci je 70 kg. Iz dobijenih rezultata evidentno je da sve posmatrane sorte imaju visoku efikasnost razdvajanja i varira u zavisnosti od sorte između 63-83%. Najniži prinos semena je pronađen u Sauvignon (13,9%) i Riesling (15,9%), najviši u različitim Andre (33,7%). Čistoća izdvojenih semena u većini uzoraka je bio relativno stabilan (76-90%).

Ključne reči: vinarija, komina od grožđa, seme vinove loze, separatora, ulje iz semena vinove loze.

Acknowledgment: The results presented in this paper were obtained within work on the NAAR Project (The National Agency for Agriculture Research Project) No. QI 111B107 „Research on the and use of biologically active substances (BAL) of grape seed to improve livestock metabolism as a basis for designing the best available techniques (BAT)", under the guidance of the Ministry of Agriculture of Czech Republic.