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USING AN EQUIPMENT WITH VIBRATING SIEVES FOR SEPARATION OF GRAPE SEEDS FROM MARC

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Abstract: In the technological process for obtaining grape seeds oil, a very important stage is the separation of grape seed from pomace. Depending on the attention paid to this stage depends on the quantity and quality of grape seed oil. Therefore, INMA Bucharest has developed vibrating sieves equipment to encourage the exploitation of vegetable waste from the wine industry. In this article, the point focus is the qualitative and quantitative separation of grape seeds from the marc of three grape varieties. At the same time, we changed the way the equipment works by changing the frequency of the equipment control panel. In this article, we aim to separate the seeds from the pomace in order to extract the oil contained in them. For this, we took into account the research in the field which confirms the fact that globally grapes are the most cultivated and widespread fruits, about 7.5 million hectares with a production of approx. 78 million tonnes and most of this is used in the wine industry.
Keywords: marc, grape seed, vibrating sieves

1. INTRODUCTION

The current trend is towards the use of environmentally friendly methods and materials in all fields (agriculture, food industry, pharmaceutical industry, etc.) and the reuse of certain waste, so that the products placed on the market have a closed cycle, leading to a circulating economy. Figure 1 shows the vinification waste circuit from the point of view of a circulating economy.

In this article, we aim to separate the seeds from the pomace in order to extract the oil contained in them. For this, we took into account the research in the field which confirms the fact that globally grapes are the most cultivated and widespread fruits, about 7.5 million hectares with a production of approx. 78 million tonnes and most of this is used in the wine industry (FAO and OIV, 2016).

Figure 1. The circuit of viticultural waste from the perspective of a circulating economy (Milea D. et.al., 2018)

The annual quantity of discarded grape seeds is over 3 Mtons worldwide, and 20% of them are considered to be waste during production. Grape seeds have protein, fiber, carbohydrates, minerals, lipids and polyphenolic compounds (5% –8%). The oil content can vary between 10% and 20%, and the percentages of oil components can vary depending on the origin, variety, soil characteristics, climate, baking level and manufacturing processes. This waste can be used for various purposes, such as the extraction of antioxidants, biotechnological production of fine chemicals, biomethane generation, composting, animal feed and incineration due to their chemical structure (Choi & Lee, 2009; Da´vila, Robles, Egues, Labidi, & Gullo´n, 2017; Spigno, Marinoni, & Garrido, 2017).

The substances contained in grape seeds can be used to obtain edible vegetable oil and natural antioxidants, which can be preferred as food ingredients and dietary supplements to promote general well–being and to prevent disease. These secondary metabolites have shown antioxidant, antimicrobial, anti–inflammatory, anticancer, and cardiovascular–protective effects, which support human health and reduce the risk of various and especially chronic diseases (Da´vila et al., 2017)

Cleaning and selection of grape seeds, aim to increase the quality indices and physical–mechanical properties. Usually, the seeds are meant to go through several processing steps, but first of all the impurities (mineral formations, weeds and plant parts) are removed. Those operations are usually designed according to the type of material to be separated, the mechanical–pneumatic separation system which is provided with smaller and smaller meshes, but also the number of passes. This combination is usually found on all high–performance equipment that works on the gravitational and aerodynamic principle, the material that passes through the sieve is known as sieving (fine sorting) and the other refuse (coarse sorting). The mechanical screening equipment is provided with several sites through which the impurities and calibration of the seeds in several dimensions are eliminated (Brăcăcescu C. et al., 2017, Milea D. et.al., 2018).

2. MATERIALS AND METHODS

For this article, we used marc from three types of grapes: Feteasca regala, Riesling and Burgundy. These were harvested from INCDBH Ștefănești, the first two are white varieties and the last one is from red varieties. In Figure2 represents the starting stage.

Figure 2. The three varities of pomace: Feteasca neagra, Reislig and Burgundy

The next step was processing the pulp. Table 1 includes the initial moisture of the pomace that it had at the reception of the material and the final moisture before separation. Drying was done naturally by spreading the pomace on perforated sheet metal frames so that the pomace could be ventilated on both surfaces. The moisture value was determined by the classical method: the pre–weighed sample is heated in an oven at 130^{0}C for 60 minutes, then cooled in a desiccator and weighed, the difference in mass representing the amount of water evaporated.

Table 1. Moisture of marc before separating seed

Varieties of pomace	Initial moisture [%]	Final moisture [%]
Feteasca neagra	58	25
Reislig	61	27
Burgundy	64	31

To separate the grape seeds from the marc we used a technical equipment namely ESSS, designed by INMA Bucharest, Figure 3, the separation is made with the help of oscillating screens and a fan system that cleans the air inside the equipment to ensure the high purity of grape seeds.

Bunker A is fed with pomace (mixture of seeds, bunches, skin and other materials), which falls into the decompaction system 1, provided with a decompaction unit of the pomace tree (grape skins and seeds). Subsequently, the raw material is separated by means of vibrating sieves 10, 11 and 13. At the first passage, coarse residues such as tailings and larger material fins are discharged through the side of the equipment D. In the second stage of separation the mixture of skins and seeds, and the average waste is then collected and transported via another trough to the outlet E. Screen 13 removes impurities smaller than the seeds of healthy grapes and then directed to the outlet C (Milea D. et.al., 2018).

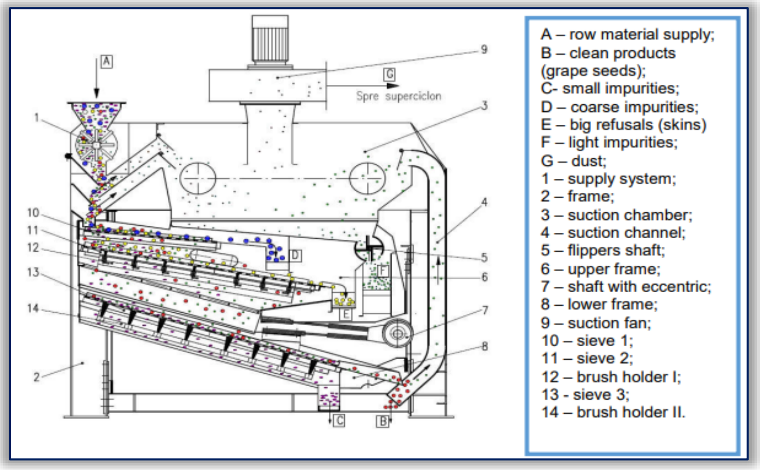


Figure 3. Scheme of separator ESSS (Milea D. et.al., 2018)

The healthy seeds are then collected in trough B, and the particles that are glued to it are sucked in by the air. The screens are equipped with cleaning brushes 12, which will be mounted on mobile trolleys on which a translational movement is printed. All systems will be positioned and supported by Frame 2 and will be covered to ensure the tightness and efficiency of the technological process (Milea D. et.al., 2018).

In this article, we looked at the quality of separating grape seeds from the rest of the marc and the efficiency of the separation equipment. Regarding the quality of the separation, it was done visually by comparing the three residues to be screened. For the separation yield we introduced a weighed amount of marc and we collected the sieves after each stage of the marc inside the equipment at the end we weighed them and calculated the yield of seeds obtained.

$$\eta = \frac{m_s}{m_m} \text{ x } 100$$

where: m_s – mass of grape seeds obtained [kg], m_m – initial mass of marc [kg]

Milea D. et.al. conducted a study at INMA Bucharest, which estimates that the percentage of grape seed in pomace is between 35–55%, depending on the grape variety. In this paper we will relate to this value to compare the results obtained.

3. RESULTS

After the drying stage, the pulp was loaded into the hopper of the separation equipment with vibrating sieve, Figure 4. We collected the refusal from each evacuation slot and visually analysed each refusal.

Figure 4. Grape seed separation equipment

The marc of Burgundy variety was passed through a grape seed separator, and in the first sieve where the sieve meshes are larger than 10 mm, the stalks, wood, stones and other materials were separated, Figure5 a, and the mixed seeds were passed on to the next step with small residues, skin and other residues smaller than 10mm.

Figure 5. Grape seed separation equipment

Figure 5 shows the four residues collected from each separation step. In the first stage, Figure 5 a, are the large residues, but we also have some seeds that have not passed this stage. In Figure 5b, are medium–sized residues, mainly dried grape skins and here we notice that among the desserts there are also healthy seeds. In the third stage, Figure 5 c, there is small waste that passed through the meshes of the sieve from the second stage, but we do not find seeds in these residues. The finest waste, Figure 5d, are the smallest and are composed of dust and residues with dimensions smaller than 4mm, and in these residues are found very few seeds mainly unhealthy seeds.

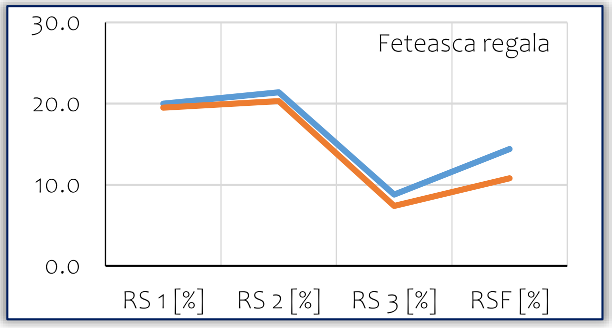
Regarding the balance of material is shown in table 2 the quantity of residues discharged from each separation stage of the equipment is displayed for each of the three grape seed varieties.

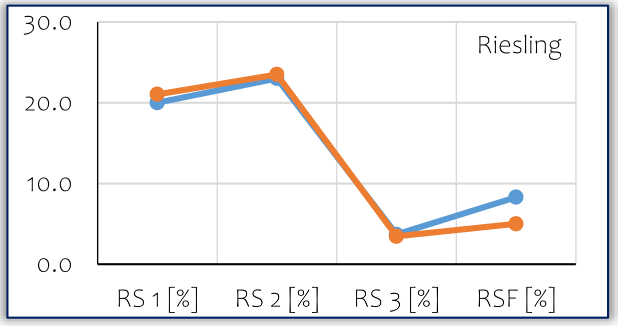
Table 2. Collected residue from equipment with vibrating sieves

Variety	Frequency [Hz]	Residuum from sieve 1 [%]	Residuum from sieve 2 [%]	Residuum from sieve 3 [%]	Residuum from suction fan [%]
Feteasca regala	25	20,00	21,40	8,80	14,40
	35	19,50	20,30	7,40	10,80
Riesling	25	20,00	23,00	3,70	8,30
	35	21,04	23,50	3,46	5,00
Burgundy	25	23,10	24,30	2,70	4,50
	35	23,90	24,60	0,70	4,80

In order to better visualize the process of separating the grape seeds, in figure 6 we have for each variety a graphic that shows the two operating regimes of the equipment. The result shows that in the first separation regime where the frequency is 25Hz, several residues are collected on each collection slot. Most of the waste was collected on the second stage of separation, but the suction of the fan has an important percentage in the cleaning of impurities and dust of the final product, grape seeds.

Table 3 shows the percentage of seeds obtained after separating the grape seeds with the equipment with vibrating sieve. As can be seen, in a higher frequency operating regime, the seed quantity is higher than in the situation when the oscillation frequency was at 35Hz. As the vibration increases, the time spent on the sieve decreases, and the impurities pass from one stage to another faster and can reach the final product.





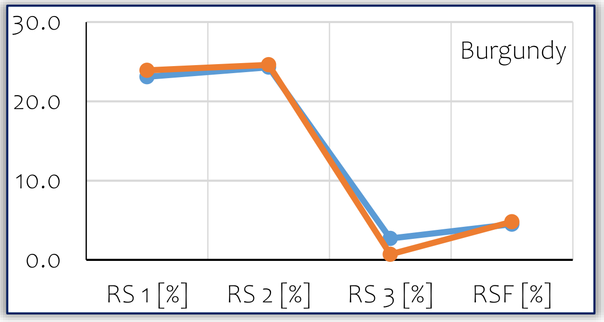


Table 3. Grape seed yield obtained from a batch for the three grape varieties

Variety	Frequency [Hz]	Grape seed yield [%]
Feteasca neagra	25,00	35,4
	35,00	42
Reisling	25,00	45
	35,00	47
Burgundy	25,00	45,4
	35,00	46

Figure 6. Chart of residues collected at each stage of separation at two operating modes: 25 Hz and 35Hz

The best yield is the Reisling variety in both modes of operation. One of the reasons why this variety has a higher yield than the other two is the presence of a higher number of seeds in the pomace.

4. CONCLUSIONS

From the point of view of the quality of the grape seed separation, the equipment still needs to be improved on steps one and two, because in these stages most of the healthy grape seeds are found in the collected residues. This is due to either a too steep sieve slope, too high a working speed, or too high an oscillation frequency.

The equipment has a good yield of grape seed extraction and is a good way to save grape seed from the marc and get oil from it.

In order to improve the separation efficiency and to save as many seeds as possible from the residues, it would be useful to break the pulp lumps before separation.

Last but not least, the yield of grape seed is also influenced by grape soil, depending on which there may be a higher amount of seeds in the marc.

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