

## METHODOLOGY FOR CONDITIONING GRAPE SEEDS TO OBTAIN OIL

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**Abstract.** The current trend is to maximize the potential of limited resources and find alternative materials to integrate into circulating economy. The wine industry remains one of the most important industries in the agricultural and food sector. Therefore, much research has focused on the reuse of marc and the extraction of beneficial elements and their reuse in new products. Once this purpose is created, the problem is to use a method and technology to separate grape seeds from most impurities. Given the above premise, in this paper, we have identified the problems that have arisen in the process of separating grape seeds from pomace and we have proposed a methodology for conditioning them. Going through the proposed methodology, the degree of cleaning of the seeds is improved by aprox. 10%, which leads to a superior quality of the oil from the seed oil and an improvement in the amount of oil extracted. In the first stage of the paper, we established the methodology for conditioning the grape seeds based on an analysis of the initial sample of the white Sauvignon marc and the red Fetească neagră variety. The main problems that prevent the separation of the seeds as easily as possible appear as a result of the grape squeezing process, because first of all the lumps of the marc are formed, and secondly a significant part of the seeds is stuck in the grape skin. We collected an initial sample of the marc and then we classified and weighed the impurities and determined the amount of grape seeds in the sample. After the completion of the seed conditioning stages, we analysed the amount of residue collected from each stage and we finally obtained a separation yield of 13% for Sauvignon pomace and 19% for Fetească Neagră.

**Keywords:** conditioning seeds, separation technology, grape marc, methodology, grape seeds.

### Introduction

The cultivation of grapevines is one of the oldest agricultural occupations, because grapes are very important in wine production. By processing 1000 kg of grapes, approximately 75% wine is obtained, the remaining 25% being pomace [1]. Therefore, pomace is the residue resulting from squeezing grapes and includes bunches (if they are not removed beforehand), skins, seeds and other materials [2]. Out of the pomace generated, grape seeds represent about 20-26% depending on the grape variety [3]. Grape seeds are high in fiber, protein and fat [4]. They are often used to make oil and flour because they are rich in bioactive compounds and minerals. The oil content of grape seeds can vary between 10-20%, depending on the type of grape and the technology used to extract oil [5]. Grape seed oil is a precious product due to its high content of antioxidants, which is highly valued in the cosmetics industry and beyond.

Extraction of grape seed oil can be done either by the classical cold pressing method or by solvent [6]. By cold pressing the grape seeds, the extracted oil is less in the bioactive compounds, proteins and mineral substances remain unaltered and therefore the quality of the oil is better. While by solvent extraction the yield is higher, however, there is a possibility that solvent residues can be found in the oil composition. In the end the solvent extraction has been improved both in terms of technology and of the solvents used which are more product friendly [7].

Regardless of the oil extraction technology chosen, oilseeds must go through one or more preparation processes so that the quantity and quality of the oil obtained is cost-effective. In general, the main activities regarding the preparation of seeds for oil extraction refer to [8]:

- drying the seeds before storage to prevent mold;
- cleaning the seeds to remove sand, dust and other unnecessary materials;
- husking of seeds where appropriate.

Balan M. et al. used the following working methodology for processing the pomace: obtaining the pomace, separating the seeds, drying the seeds, conditioning the seeds, storing the seeds. This methodology is simple and has the disadvantage of losing a large amount of seeds during the separation process [9].

Jorge Dominguez et. al conducted a study on the simulation of technology for obtaining biofertilizers from plant residues, from pomace and biocomponents from grape seeds. During this

technological process, it was found that the grape seeds are intact and do not show damage as a result of the technological process, at the same time in this process aeration and mixing of the raw material are ensured because the earthworms also have this role [10]. The described procedure is efficient, simple, environmentally friendly and economical, and can be easily extended to industrial applications, obtaining a variety of value-added products from the original grape pomace.

Preparation of seeds for oil extraction is established depending on the type of seeds and their degree of impurity [11].

Visan et al. used a two-step separation to increase seed cleaning and seed quantity. One of the stages of separation is by washing the pomace, and the next is by sifting it. The methodology for processing the pomace is: pomace and plant materials, primary separation with a washing unit, drying the pomace, final separation by sieving, and seed storage [12].

## Materials and methods

The grapes were harvested in 2021 from the Viti-Viticola Research and Development Station (SCDVV) in Murfatlar, Romania, which is located in the southern part of the country near the Black Sea. The cultivated area is 99 ha and includes 10 types of grapes, both white and red. In 2021, the crop suffered severe blight attacks and the intense growth of weeds, which led to a decrease in the grape harvest. This year's harvest was  $5 \text{ tons} \cdot \text{ha}^{-1}$ , approximately 2800 hectoliters of good quality wine were obtained [13].

For this paper, we used the white Sauvignon marc and the red Fetească neagră variety, which was delivered to the INMA Bucharest headquarters. The first stage after receiving the grape marc was to establish a processing methodology that also includes the equipment necessary for the operation. In Fig. 1, the technology of separation of grape seeds is presented, which aims to recover as many seeds as possible whilst keeping a low degree of impurities.

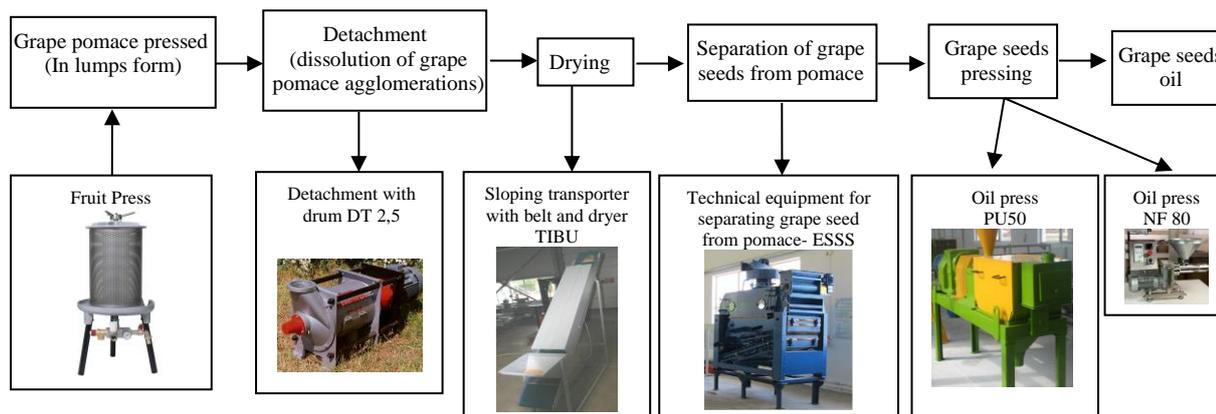


Fig. 1. Grape seed separation technology

For processing of pomace, in order to obtain the oil from grape seeds by cold pressing, we established the above methodology in which we chose the technologies which will serve to fulfill the stages. This equipment is part of INMA Bucharest portfolio.

Grape pomace (GM) comes out of the wine production process after the grapes are pressed to release the juice. Due to the applied pressure, lumps are formed which, once dried, are difficult to process during the separation stage due to the fact that the seeds remain trapped in them. For this reason, in order to recover a larger quantity of pomace seeds, it was decided to use a DT drum detacher with a capacity of  $2.5 \text{ t} \cdot \text{h}^{-1}$ , which loosens the agglomerations of material leading to a higher yield by the sieves used in the separation stage. In Fig. 2, we can observe the state at entry of the pulp into the DT 2.5 equipment and the appearance of the pulp after the completion of the agglomeration breaking stage. In this process the integrity of the seeds is not damaged.

Upon the reception, grape marc has a humidity of 54.44% for white grapes and 45.25% for red grapes. Prior to processing, the grape marc was laid out to dry naturally at a temperature of  $28 \text{ }^\circ\text{C}$  in a heated and ventilated hall for two weeks, and the humidity decreased to 33.91% and 23.69%. Prior to

the separation procedure, the marc passed through the inclined conveyor belt and dryer, which reduced the humidity to 10% and 8.5%.



Fig. 2. Breaking grape marc agglomeration with DT 2,5 equipment

The step of separating the pulp is carried out according to the diagram in Fig. 3, using three flat vibrating screens on the ESSS equipment. The first sieve has a length of 745 mm and a width of 605 mm, on which round holes with a diameter of 10 mm are arranged. The second and third sieves have elongated zigzag holes with a length of 25 mm and a hole width of 7 mm and 20 x 3 mm, respectively.

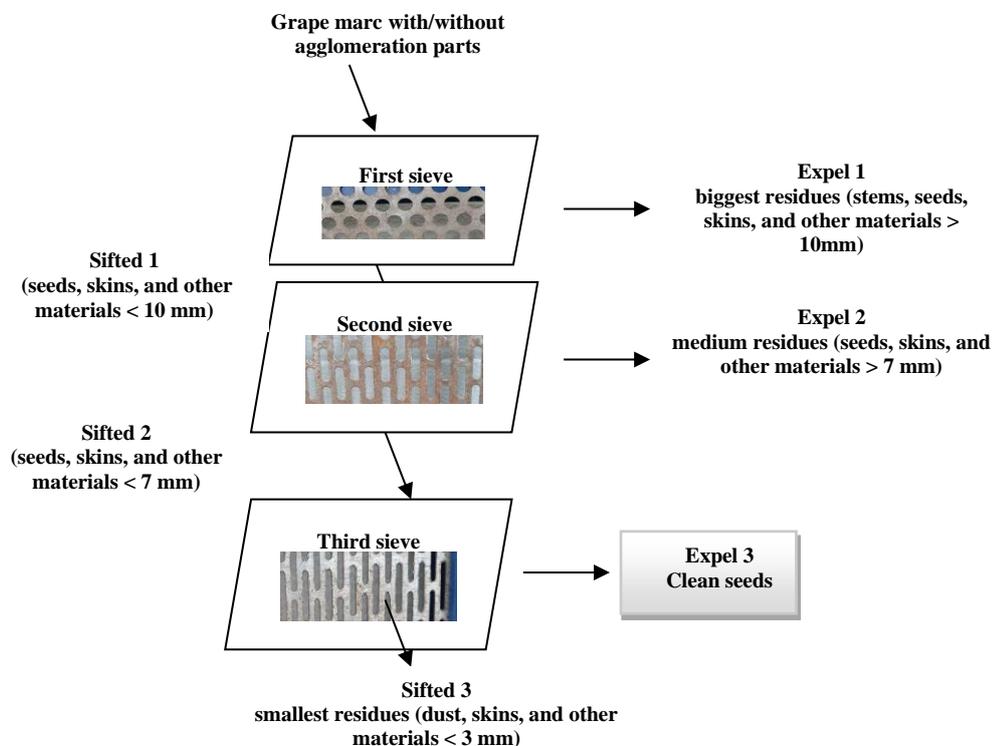


Fig. 3. Separation of grape seeds with ESSS equipment

For this experiment, we fed the equipment with 20 kg of grape marc which was separated on the three vibrating plane sieves, and after each step, we collected the discharged material and the last sifted product to compare the number of residues and materials obtained. We went through the stage of separating pomace with agglomerated parts, but also pomace without agglomerated parts, after which we weighed and compared the results obtained for each type of grape pomace (red and white). The experiment was carried out three times for each grape pomace.

From each level of discharged material, we collected 100g to determine what losses of grape seeds we had during the tests. We also compared the purity of the seeds. Finally, the seeds obtained were used to extract the oil.

## Results and discussion

During the separation of grape pomace without elimination of lumps, there is a tendency to produce larger residues (larger than 10 mm) from the first sieve in a proportion of 29.74% for Sauvignon

compared to 19.7% in the case of grape marc without lumps. For Feteasca Neagra, the differences in terms of the amount of residue on the first sieve are 28.88% compared to 21.22%.

To conclude, considering the case of the first sifter, in which the pomace without agglomerated parts was sifted through, a reduction of the expelled residues was noticed. This case study is displayed in Fig. 4-5 in orange.

Regarding the case of the second sifter, it is observed that the tendency is similar, which is that of collecting a larger number of residues in the experimental phase with the grape marc containing agglomeration parts. These lump formations which appear in the marc include a large number of seeds, skin and grape stem. Unfortunately, the seeds lost in these stages are difficult to recover without the use of additional equipment. To be noted that the highest amount of expelled residue was weighed on the first sieve whilst processing the marc which contains agglomeration parts and the reason for this result is the above-mentioned lump formations which weigh heavier and prevent the marc from being properly sifted.

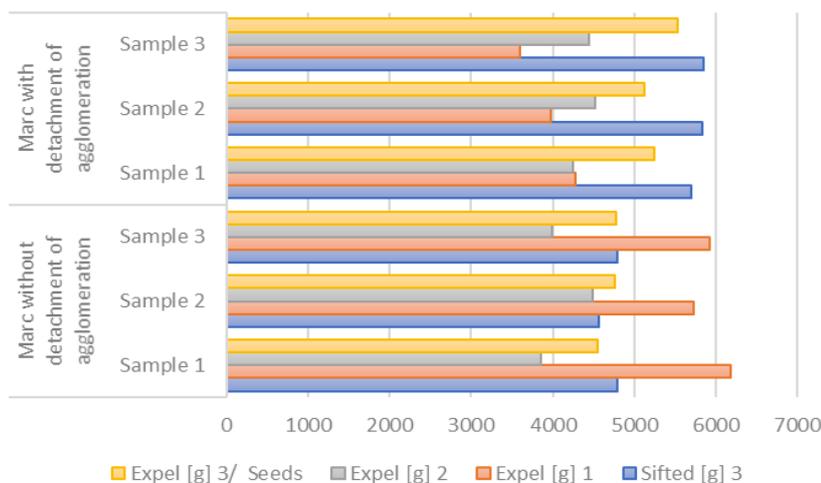


Fig. 4. Sauvignon marc separation

In the experimental phase, where grape marc without agglomeration parts was sifted, the quantity of seeds evicted from the sifter 3 increased by 13% while using the grape pomace from Sauvignon grapes and by 19% for Fetească Neagră grapes.

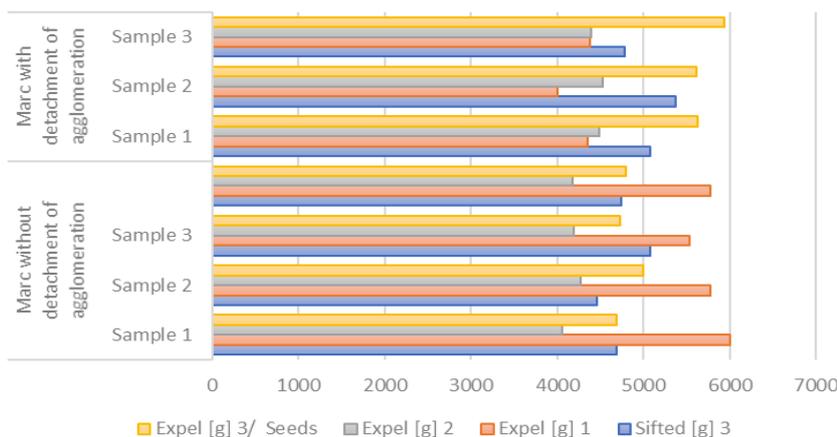


Fig. 5. Feteasca Neagra marc separation

In Table 1 we can observe the yield resulted from separating the grape pomace between the two types of grape seed experiment. In the below table, you can see a reduction of the number of wastes discharged on the sieve 1 that migrated to the other two sieves.

Table 1

**Separation yield between grape marc with and without agglomeration parts**

Grape marc	Sifted	Expel 2		
	3	1	2	Seeds
Sauvignon	23%	-34%	7%	13%
Fetească Neagră	7%	-27%	7%	19%

**Conclusions**

1. In Table 1 it is observed that on the first sieve the amount of residues discharged is smaller in the case of the sample with pulp without lumps. For the type of pomace from Sauvignon grapes it is lower by 34%, respectively 27% for the type of Fetească Neagră. This decrease is due to crushing of residues and release of seeds, which pass through the first sieve and separate in the second sieve where an increase in the amount of residues collected is observed by 7%.
2. The passage of the pomace through the agglomerated part detacher resulted in an increase of 13% and 19%, respectively, in the degree of recovery of the grape seeds.
3. In the case of sifter 3, there is an increase in the amount of residues collected by 23% for Sauvignon and 7% for Fetească Neagră, respectively.
4. In conclusion, the introduction of equipment to break the pulp lumps into the pulp processing stream has the advantage of increasing the amount of separated seeds and decreasing the degree of impurities remaining after separation. But it has the disadvantage of increasing the production costs by consuming energy related to the equipment.

**Acknowledgements**

This paper is financed by the Ministry of Research, Innovation and Digitalization through Program 1 – Development of the national research-development system, Subprogram 1.2 – Institutional performance – Projects for financing excellence in RDI, Contract no. 1PFE/30.12.2021

**Author contributions**

Indicate the contribution of each author. Example: Conceptualization, B.C.; methodology, P.A and B.C.; investigation, B.C., A.D., M.M. and B.S.; writing – original draft preparation, B.C.; writing – review and editing, B.S. All authors have read and agreed to the published version of the manuscript.

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