# Grape seed drying in fluidized layer using SHF energy

**Mircea BERNIC**, **Marcel MAȚCO**, **Eugeniu CIOBANU**,
**Iurie DOHMILĂ** and **Nicolae CHIRIAC**

Technical University of Moldova, 168 Stefan cel Mare St., MD-2004 Chisinau, Republic of Moldova
Phone: +373 22 31.90.92, Fax: +373 22 31.91.76, E-mail: m_bernic@mail.utm.md,
matcomarcel@mail.ru, eugeniu.ciobanu@mail.ru, n.kiriak@gmail.com

**Abstract**

The grape seeds among the by-products whose recovery is considered to be interesting for all the wine making countries. Although the grape seeds are considered as waste from grapes processing in the wine industry, they present a rich variety of different materials required for use in food. For their extraction there is necessary to dry the seeds and separate them from clusters, core and peel. It is proposed an installation for grape seeds drying in fluidized layer, using SHF energy.

**Keywords**: seeds, SHF, microwaves, drying, fluidized layer.

**Rezumat**

Semințele din struguri figurează printre subprodusele vinicole a căror valorificare este apreciată ca interesantă în toate țările vinicole. Cu toate că semințele de struguri sunt considerate ca deşeuri în urma prelucrării strugurilor în industria vinicolă, ele prezintă un conținut bogat de diferite substanțe necesare utilizării în industria alimentară. Pentru extragerea acestora este necesară uscarea preventivă a semințelor şi separarea lor de ciorchini, miez şi pieliță. Astfel este propusă instalația de uscare a semințelor de struguri cu energie SHF şi strat fluidizat.

**Cuvinte cheie**: semințe, struguri, strat fluidizat, câmp SHF, deşeuri vinicole.

## 1. Introduction

Recovery from grapes processing is a strategic focus of the wine sector, helping to obtain new functional products and reduce environmental pollution effects. Grape seed oil extraction is performed by pressing or extraction with various organic solvents. Extraction yields were relatively modest, leading to abandonment of this operation.

Recent research, which revealed the compositional complexity of the oil extracted from grape seeds and showed beneficial effects on health, have spurred consumer interest in this product.

Grape oils specific chemical compounds are unsaturated fatty acids, phenolic compounds, hemicellulose, tocopherol.

Pharmaco-dynamic potential of grape seed oil has been shown to reduce the effect of cholesterol because it contains antioxidant substances and reduced energy intake, which causes him to be recommended for food diets. Grape seed oil, essential fatty acids because it contains can be used in cosmetics and pharmaceutical industry.

## 2. Materials and methods

### 2.1. Grape seeds as a study subject

Grapes consists of bunches and grains, which contain 1-4 small, tough seeds. The amount of grape juice and structural elements (bunches, peel, seeds, core) depend on grape variety, agro-biological factors, pedo-climatic conditions and others agro technical factors.

On average mechanical components of the grapes are the following indexes: brunches -3.5%, core - 84.4%, peel - 8.4%, seeds - 3.7%. In different years and different regions, large deviations of these indices are possible. The chemical composition of the brunches, peel and seeds is of great importance in the process of producing different types of wines.

Grape seeds are obtained from fresh and fermented marc, obtained after pressing the fermented pomace. Bibliographical study of grape seeds properties was based on studies of following properties:

- *Physical properties*

Dimensional parameters of grape seed are within: length 4.5–7.0 mm, width 3.0–5.0 mm; thickness 2.0–3.5 mm; weight of 1000 grape seeds is about 20–21 kg.

- *Chemical properties*

According to experimental data obtained by N. Razuvaev (1974, 1975, 1977, 1982, 1983), before drying grape seeds contain: water 30-40%, tannin 3-7%, minerals 1-2%, oil 8-10%, cellulose 44-57%. The dried marc contains 40-65% of seeds containing 12-22% oil. V. Licev (1974) shows that grape seeds contain: water 25-45%, hydrocarbons 34-36%, oil up to 20%, tannins 4-6%, phenolic substances 2-4%, nitrogenous substances 4-6%, minerals 2-4%, fatty acids up to 10%, cellulose 10-11%, lignin 25-28%. While processing 100 kg of seeds, we can obtain up to 23 kg lignin, which presents a very valuable raw material.

- *Medicinal properties*

Therapeutic effects of grape seed oil are more pronounced in oil obtained by cold pressing method. It is imperative to avoid oil frying or boiling, because heat treatment at 50°C leads to alterations in therapeutic properties. It is successfully used in cosmetics as a solution for skin massage, which supplies biologically active substances, prevents its loss, help maintain the natural elasticity and youthful.

- *Mechanical properties*

Slope angle for grape seeds is 37o. Friction coefficient consists: 0.481 ÷ 0.536 (on steel), 0.573 ÷ 0.662 (on wood) and 0.496 ÷ 0.554 (on concrete). Grape seeds density is about 446 ÷ 558 kg/m3.

## 3. Results and discussion

Analysis of the diagram in Figure 1 demonstrates that existing fresh marc processing technology is very complicated and requires use of a whole complex of technological processes. By pressing or extraction processes of grape seed oil, we get technical or cooking oil, and the meal formed after pressing is used as animal food. Food-purpose grape oil is used in different directions, such as cosmetics industry and pharmaceutical industry. Technical grape oil, because of used extraction technology, is not spread in the national economy.

One of the key processes that affect the quality of finished products, especially oil, is drying. Only the correct choice of heat treatment regime and its duration can ensure the preservation of biologically active substances in the oil and prevent its irreversible oxidation processes. Following the literature review, we can say that the intensification of drying process at relatively small temperature can be easily achieved by combining the drying process in fluidized bed and microwave (SHF).

The main advantages of fluidized bed dryers are:

- Increased intensity drying; elimination of moisture in the material is several times faster than with conventional dryers;
- Reduced heat consumption; for example, to obtain 15 to 30 t/h of dried product, with moisture reduction from 2.8% to 0.1% is consumed 100-120 kJ/kg compared to 190-320 kJ/kg in convection dryers;
- Uniform and controllable phase temperature, for most of the fluidized dryers, can be raised up, interfering with convection and radiation heat; low temperature dryers (tg<80 oC) are used only for thermo labile materials (cereals, pharmaceutical powders, food, etc.);
- Reduced drying time compared with conventional dryers; in fluidized bed dryers, it is the order of minutes or seconds, also can be a combination with pneumatic dry, by picking a short stationary time for the material in the dryer flow;
- Possibility of process combination; the dried material may be driven pneumatically, mixed, sorted and cooled by using multiple steps;
- Small dimensions and compact construction;
- Drying process automation and optimum regime achievement.

One of the basic disadvantages of fluidized bed drying with convective power input is considerable heat losses with drying agent. The solution for this problem can be directly product heat using the power of electromagnetic fields (microwaves).

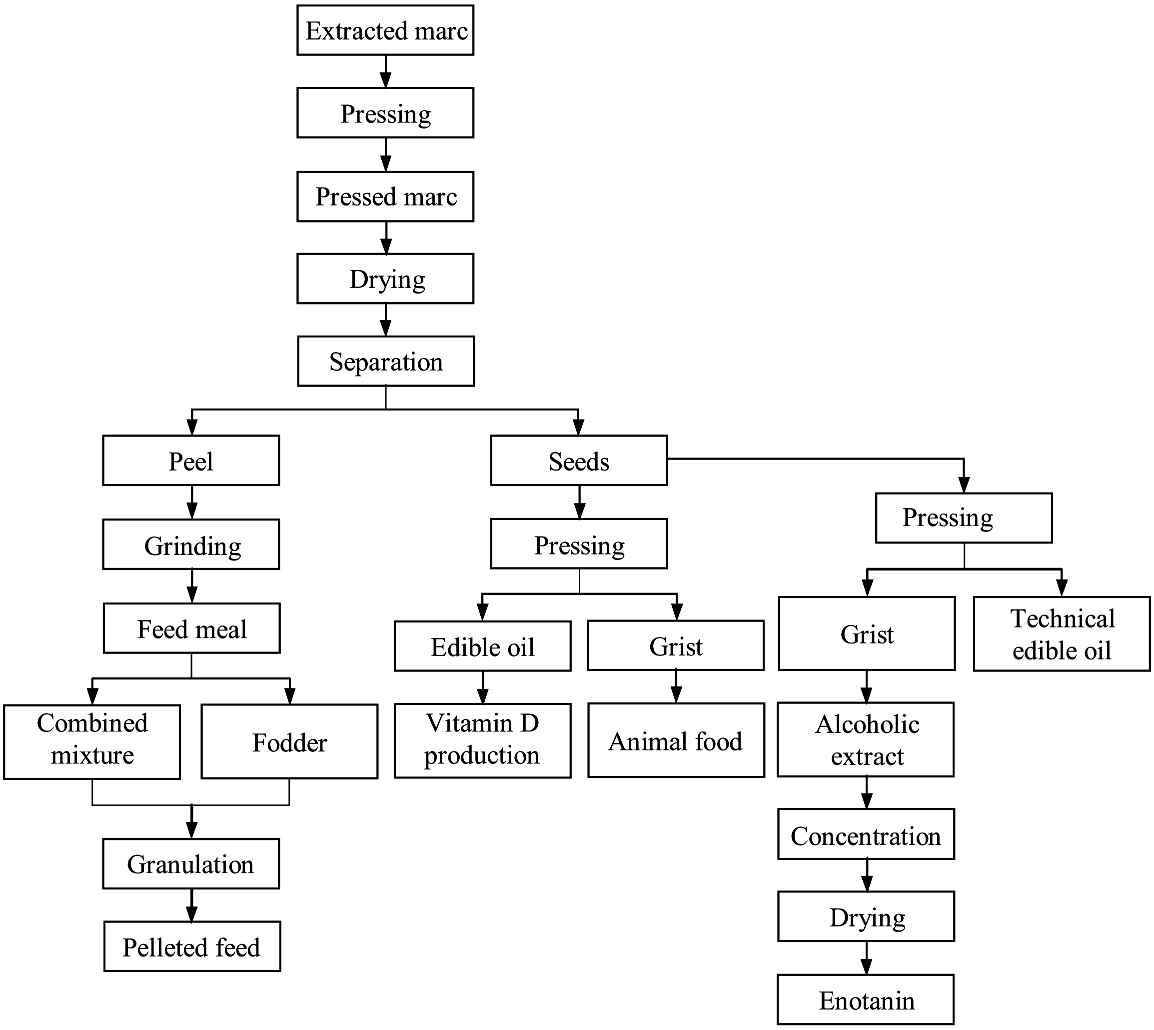


***Figure 1.*** The main technological scheme for fresh grape marc processing

### 3.1. Advantages of SHF dryers

As heating convection, heat source causes the reaction of molecules from surface to center, so the molecules are heated in successive layers. Product area may be threatened with overheating during thermal processing of products. Microwaves, however, create a heating effect in the whole volume. All molecules are put into action the same time and form the temperature gradient, offering other important advantages. Microwave heating and drying, and dielectric energy is distinct from the ongoing slow heating inside the material, as determined by the difference of temperatures, hot on surface and cold inside, dielectric heating and microwave energy is actually heating in bulk, in which electromagnetic fields interact with the material as a whole. Heating occurs almost instantaneously and can take place very quickly, although not to be. However, the heating rate may be an advantage, and it is often possible to achieve in seconds or minutes what could take minutes, hours or even days, to heat convection or microwave dielectric include the following:

– uniform heating throughout the product mass, avoidance of local burns;
– quick mass and heat transfer which as a consequence, reduces the duration of heat treatment during drying;
– high temperatures in the product are obtained without preliminary preheating;
– presence of the temperature gradient directed from the center to periphery accelerates mass transfer within the product;
– reduced energy consumption by reducing the moisture movement resistance inside the productive and in some cases partial removal of moisture in liquid form;
– inclusion of microwave treatment in a technological chain is simple, because the treatment is of short duration;

– possibility of full automation of the drying process;
– installations are easily achieved depending on product and quantities to be made;
– microwave heating is not polluting as not raise the ambient temperature.

Combination of convection and microwave fluidized heating reduces the creation of a high temperature environment both around and inside the product surface, which influences and eliminates the humidity from the product surface.

In base of drying process study, performed at "Industrial Technology Equipment" department, Technical University of Moldova, it was designed an industrial installation for grape seed drying, using combined fluidized microwave power input.

The installation includes the following main parts (Figure 2): a supply hopper (loading chute), a vibrating perforated plate 6 and a drying chamber 5.

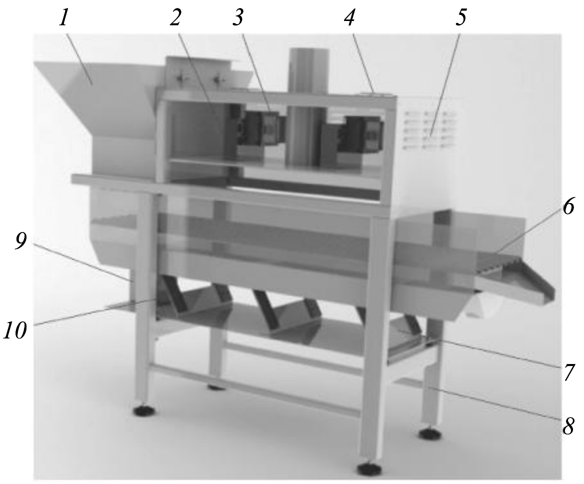


***Figure 2.*** Industrial grape seed drying installation
1 – bunker, 2 – handle, 3 – magnetron; 4 – fan, 5 – drying chamber, 6 – perforated plate, 7 – support, 8 – housing, 9 – electromagnet; 10 – glass fiber plate.

The vibrating plate is designed as a straight framework 6, suspended oblique on elastic plates 10, and through bracket 7 is secured to the base 8. When connecting the AC electromagnet 9, the anchor 7 together with the plate 6 makes periodic oscillations. Speed of product's movement through the workroom, and hence the treatment duration is adjusted by changing the plate's amplitude and frequency oscillations. Damping springs are mounted in order to reduce the transmission of dynamic forces on the foundation.

Fluid layer is created due to oscillations of plate 6 and flows' kinetic energy to the fan-circulated air through the perforations of the same plate 6. Airflow velocity was coordinated with the floating speed and was 7.4 m/s.

In the drying chamber 5 it was assured a field of 2450 MHz, microwave frequency generated by two magnetrons 3 with power of 600 W, through two waveguides. Magnetrons are cooled by fans 4. The products' temperature generated by microwaves is directed through a system of automation by a magnetrons' regularly for short periods of time.

Directed movement of product through the working chamber from the loading chute is provided by the plate's angle.

Fluidized bed and microwave field drying takes place in the working chamber; the evaporated moisture from the surface of particles is driven by air flow and removed from the installation by pipeline.

## 4. Conclusions

The proposed installation gives the facility to reduce the duration of the drying process compared to convection in the dense layer 2.1 times more, and compared with pure fluidized layer – 1,4 times more. Due to uniform heating throughout the product layer, there have been avoided local overheating and burning of the product.

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