Fruit Growing Research, Vol. XXXIV, 2018 DOI 10.33045/fgr.v34.2018.26
http://publications.icdp.ro/index.php

TEHNOLOGIE DE PROCESAREA A FRUCTELOR PERISABILE ÎN VEDEREA CREŞTERII VALORII ADĂUGATE LA FERMIERII DIN POMICULTURĂ
PERISHABLE FRUITS PROCESSING TECHNOLOGY THAT GROWTS THE ADDED VALUE TO FARMERS IN FRUIT GROWING

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Abstract

Rising the added value to fruit growing products can be achieved by developing adequate technologies to ensure food security, food safety and to increase farmer income. Many farmers are pursuing the news applications and technologies dedicated to post-harvesting processing of their horticultural products, beginning with most commune instruments and finishing with the most efficient ones. The technology that will be presented in this paper consists of a number of equipment related to each operation, namely: washing, extracting kernels, drying, and packaging. In this technology it is implemented an equipment dedicated to extract the stone fruit kernels with several work stations, and the drying equipment (with or without kernels, in accordance with applied technology). Based on the experimental data done in exploitation conditions, will be made a comparative study for different kind of fruits, and will be drawn conclusions and recommendations regarding the process optimization. This technology was special design to be implement in small farms in order to rise the products added value.

Cuvinte cheie: tehnologie procesare fructe, separare sâmburi, cireșe, prune.
Keywords: fruit processing technology, kernel extraction, cherries, plums.

1. Introduction

In the current context, where the exploitation of the family farms is not achieved the capitalization of un-accepted for fresh fruit production, as well as, that in the years with record productions there is the depreciation risk of drupelets and juices fresh fruit, it is necessary to approach innovative technologies and technical equipment to solve these problems. The scientific research has the objective to solve these problems by developing the new technical solutions and to automatize them in order to reduce losses during the post-harvesting process of fruits, which can lead at the end to increase the products diversity and natural fruit products competitive.

The fruit processing technologies have a complex operation mode, and there are successfully used in jams preparations, compost and jellies directly on the fruit growing farmers that in Romania are present in familiar farmhouse. The mechanization and automatization level of those installations are influenced by the operation kind and for this reason are used a large variety of equipment's and the productivity.

In Fig. 1, is presented an innovative technology designed for perishable stone fruit processing in order to added value and can be adapted and configured to the needs of all producers and processors in the food industry, namely fruit based products, as: dehydrated & freezing fruits, but also for products as candied, jam, sweetness and juices. The first category consists of conserving the fruits in their initial shape and the second category is more complex because it can conserve them due to several a processing technologies: candied and sweetness technology – commonly used in cake industry and pasteurization and sterilization technology – food industry.

At the end of this chain are placed the packing technologies and sometimes the sterilization ones, this trend is encouraged by the food processing researchers because the sterilization in containers (jars, metal caned, vacuumed plastic packaging and in innovative packaging recipients) assure a high food safety and a greater conservation period, due to low post-processing contamination and ensuring nutritional and tasteful products.

The sterilization process can be done in several methods in bulk and in small recipients, the first method is usually used for industrial processing (sterilization of a raw material and the packed in septic recipients under a contaminated and controlled environment) but for small producers it is more practical and commune the small containers (sometimes before the sterilization process is made the pasteurization operation in order to decrease the number of high temperature sensitive microorganisms that can deteriorate the product) that are emerge in the high temperature fluid (above 120÷130 ^{0}C) a certain period of time placed in a pressurized chamber, this process is time consuming but the contamination risk is minimized, for this reason in the Fig.1, were represented this types of machines.

If it is analyzed the technologic flow chart, it can be concluded that the essential processing equipment is the pitting machine, known by non-celebrities as kernel extraction equipment, because in this way it can be assured the fruit quality to be processed in order to add value. If this equipment is not working appropriate, namely to extract whole kernel and not to leave pieces of it in the fruit, can damage the technological flow and equipment's used (slicers, presses and can cause blockages in closed loop pneumatic conveyor systems), but also the quality of the processed food (bitter, bits, non-homogeneous structure, etc.)

Taking a close look of the pitting machines on the market are commercialized several models, ones have a commune structure and the others presents a complex design, as it can be seen in the Fig.1, in accordance with this criterion is setting the acquisition price, a very important criteria if it is taking in to consideration the products market impact, marketing plan and the production capacity. In case of small stone fruit processors and family business it is more adequate less complex equipment with low production capacity, like the one designed by INMA Bucharest institute, Fig. 2.

Lately, due to the market requirements the fruit pulp suppliers are interested to have a complete separation of the kernel. This aspect is very important for cherry and plum fruit growers, because they must obtain a high food security requirement starting form fruit growth until the final fruit pulp, in order to ensure orchards holdings stability and agricultural revenue for farmers.

2. Material and methods

The kernel removal installation, Fig.3, was design to fruit capitalization by removing the kernel from them in order to obtain jams, juices and other food products. The main components of this installation are: 1 - the installation frame, 2- rubber drums, 3- discs drum, 4- drum discs scraper; 5- rubber drum scrapers; 6- guillotine;7- motor transmission (motor, gearbox, chain wheels, chain); 8- collecting troughs for pits, pulps, syrup and supply gutter and 9- separator.

The rubber drum is made from a specific food rubber (40 Share hardness) and the discs drum is made from 10TiNiCr180 plates. The plates press the fruit pulp and the rubber drum is deformed and captures the kernel. The discs drum scraper is made from a knife set correct placed at a certain distance using the ring spacers, in order to detach the pulp, instead the rubber drum scraper detaches the kernel from the drum.

Role of the guillotine assembly is to make an advance-withdrawal motion on vertical direction in order to assure a certain force on the fruits between those two drums where it takes place the separation process. The actuation system applied on it is made by an eccentric mechanism and two connecting rods in order to slid on vertically.

The installation presents gutters and trays made from 10TiNiCr180 to evacuate the pulp, kernels and juice resulted from the separation process

The installation working principles is based on fruit cutting operation until the kernel and its fully removal by the rubber drum and then collected by the gutters. Before processing the fruit, pigtails must be removed and then washed in order to avoid any kind of contamination. The fruits are supplied manually or automatic in the supply funnel.

The installation technical data are: working capacity 300 ÷400 [kg/h]; engine power 1.5 [kW]; BONFIGLIOLI geared of 1420 [rot/min] and i=20; drum rotary speed 41 or 31 [rot/min]; the working fervency of the guillotine 70 or 52 [cd/min]; gauge 1200x950x1500 [mm], weight 530 kg.

3. Results and discussions

The kernel separation installation had been tested in exploitation conditions as: type of supplied material (fruit): cherries and plums; the ripeness level – ripped; the impurity grade 1.1; the product quantity on one pass 8 [kg]; process adjustment samples made on 3 cherries and 3 plums.

The working parameters adjustments: discs drum rotation speed 33.21 [rot/min]; rubber drum rotation speed 33.21 [rot/min]; the drum peripheral speed 31.3 [m/min]; the guillotine fervency 57.36 [cd/min]; drums distance 3 [mm]; the guillotine distance from the drums 3 [mm]; the distance of the scrapers from the drums 2 and 1 [mm]; the material supply is made manually.

In table 1, are presented the finical properties of the material supplied in to installation during the experimental procedures, those specifications are important and influence the results obtained.

Dimensional determinations regarding the physical properties of the material used in experiments, respectively fruit and kernel dimensions, were presented in Table 2 for bought materials (cherry's and golden plums).

Analyzing the results can be concluded that cherry fruit had a diameter variation of 2.6 [mm], between the minimum and maximum value, instead for plums was of 3.8 [mm]. The height variation for cherry is 1.8 [mm] and for plum 4.9 [mm].

In Table3, are presented the results obtained from the kernel extraction operation on the plums but also on the cherries. Form those data presented in this table, it can be concluded that, the cherries can be processed better than the golden plums, average value of unseparated kernel at cherries is higher than plums (around 4.03), and the losses are smaller (4.3 rate), but the kernel separation percentage is greater. This phenomenon is influenced by the fruit pulp texture and ripeness grade, observation that is supported by the results presented in category of pulp rate on kernels.

The exploitation research conducted on this installation had be done in order to underline the performance of this method of extracting kernels from the stone fruits and the parameters that must be taken in to consideration to control the extraction process and low wastes.

4. Conclusions

Analyzing the experimental values and the performance indicators for those two types of processing materials can be concluded the next observations:

- the raw material qualitative parameters had a greater influence on the performance of the installation and on working process but also on the kernel separation rate from the pulp;
- in case of cherries processing, it was found that, there are kernels into the separated pulp and at the same time the pulp was crushed;
- in the case of plums processing, the plant realizes a very good kernel separation from the fruit pulp and there is a very small percentage of pulp of kernel surface;
- after the kernel washing and drying, it was found that they contain about 11.2 % of their weight of pulp on their outer surface.

The presented data may be important for all the farmers owning orchards and aim the fruit processing on the farm in order to capitalize their own fruit production and obtaining of important revenues for them.

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Fruit Growing Research, Vol. XXXIV, 2018 DOI 10.33045/fgr.v34.2018.26
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Tables and figures

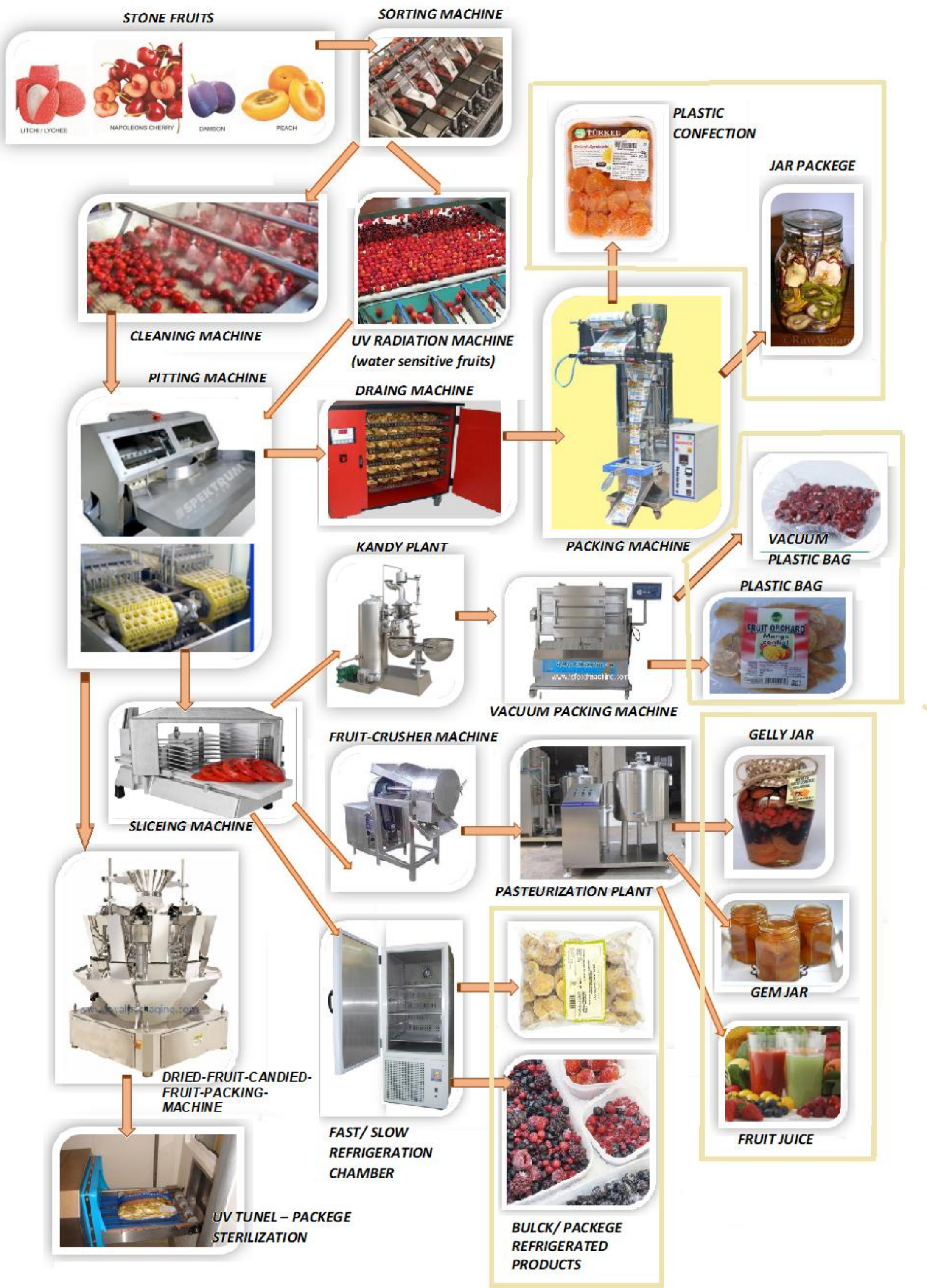

Fig.1. Perishable stone fruit processing technology to increase added value

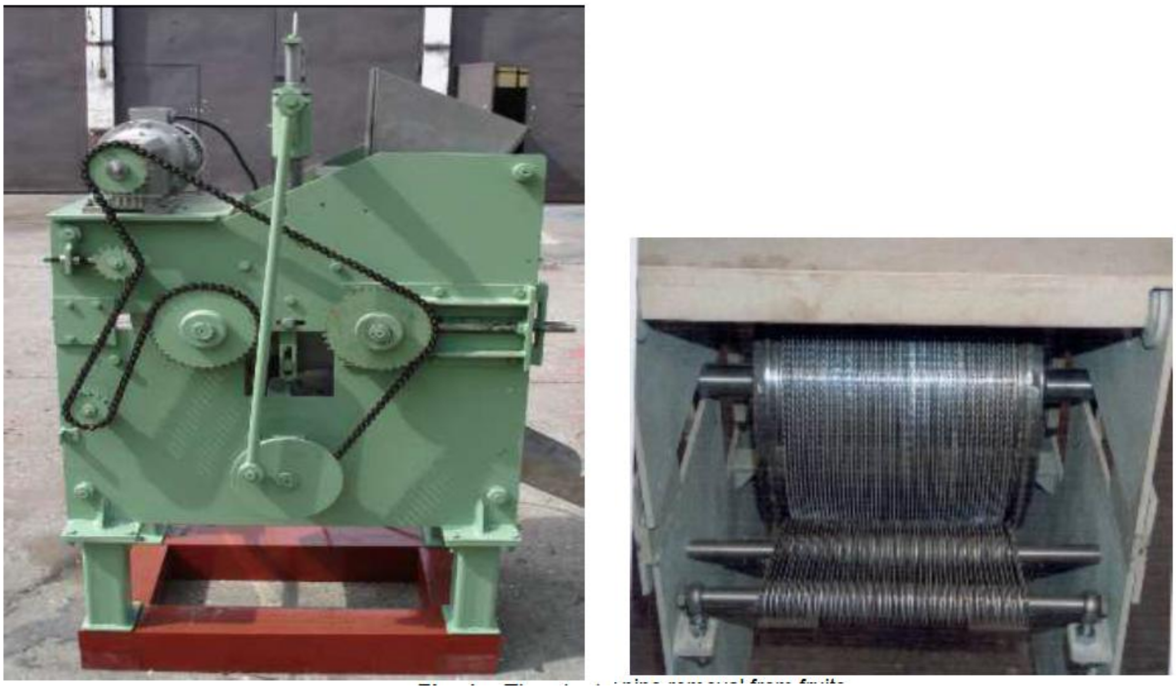

Fig. 2. Pitting machine designed by INMA. (Paun A. at al., 2015)

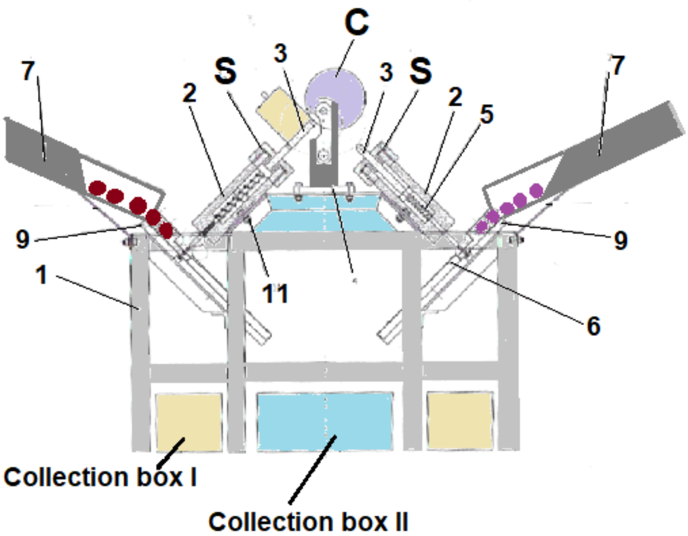

Fig. 3. Kernel extraction installation representation (Ghiţă I., at al., 2014)

Table 1. Quality of the supply material used in the exploitation experimental condition (Paun A, at al., 2015)

Parameters	Cherries- material	Golden Plums - material
Impurity percentage	1.5	0.9
Sample weight [kg]	8	8
Average weight of 100 pieces [kg]	0.262	4.25
Average pieces on sample	3050	188
Average weight of 1 piece [gr]	2.62	42.5
Average weight of 100 kernels [gr]	30	170
Kernel rate of the total material	11.43	4.16
Pulp rate of the total material	88.57	95.84

Table 2. Dimensional measurements of physical properties of experimental material

Sample no.	Measured dimensions									
	For 10 fruit pieces				For 10 kernels pieces					
	Diameter ø[mm] Cherry/ Plum		Height H [mm] Cherry/ Plum		Thickness T[mm] Cherry/ Plum		Width W [mm] Cherry/ Plum		Height H [mm] Cherry/ Plum	
1	14.5	40.0	16.8	51.1	6.1	8.5	7.7	14.6	8.8	26.1
2	15.3	38.1	17.8	51.3	7.5	7.2	9.0	14.9	9.6	25.8
3	14.2	40.2	17.3	48.3	6.8	6.3	7.6	15.0	8.3	25.7
4	14.1	36.5	17.5	46.2	7.1	7.2	8.2	16.1	9.1	26.2
5	12.7	39.7	16.5	50.3	6.8	7.1	8.5	15.3	9.0	27.5
6	15.1	39.1	17.6	49.6	7.3	7.3	8.8	16.0	9.8	28.3
7	13.6	39.6	16.8	50.1	6.6	7.5	8.0	15.4	8.8	29.1
8	15.1	40.1	18.2	51.1	7.6	8.1	8.6	16.1	9.4	26.5
9	13.8	40.3	17.7	50.6	7.2	7.2	8.5	15.6	9.3	25.2
10	14.2	40,.1	18.6	48.9	7.3	7.0	9.5	15.9	9.4	25.3
Average value	**14.26**	**39.4**	**17.48**	**49.7**	**7.03**	**7.5**	**8.4**	**15.5**	**9.15**	**26.6**

Table 3. Experimental data sheet on the cherry and golden plum collected samples

Measured parameters	Sample 1		Sample 2		Sample 3	
Material type	Cherry	Plum	Cherry	Plum	Cherry	Plum
Sample weight [kg]	8	8	8	8	8	8
Kernel separated quantity [kg]	1.153	0.33	1.130	0.338	1.096	0.340
Pulp and juice quantity [kg]	6.806	7.612	6.838	7.630	6.802	7.618
Material losses [kg]	0.041	0.555	0.032	0.032	0.102	0.041
The percentage of processed material	99.475	95.15	99.6	96.03	98.725	98.02
Kernel quantity in the separated mass	0.042	0	0.048	0	0.052	0
Unseparated kernel	3.5	0	4.1	0,001	4.5	0
The rate of pulp on kernels	-	1	12.23	1.2	12.54	1.3