The 4th International Conference
"Computational Mechanics
and Virtual Engineering"
COMEC 2011
20-22 OCTOBER 2011, Brasov, Romania

RESEARCH ON THE IMPORTANCE OF USE VENTILATION FOR DRYING TOMATOES, CARROTS AND APRICOTS

A.L. MARIN[1], Gh. BRĂTUCU[2]
[1] Transylvania University, Brasov, ROMANIA, deea_marin2007@yahoo.com
[2] Transylvania University, Brasov, ROMANIA, gh.bratucu@unitbv.ro

Abstract: *In this paper is presented the importance of using a ventilation system during drying plant products, in this case for tomatoes, carrots and apricots. In all drying equipments the ventilation system plays a very important role because it keeps constant the drying temperature, ensure the uniform spread of the drying agent throughout the drying chamber and also helps to evacuate the excess water from the drying chamber, increasing the process efficiency. For tomatoes, carrots and apricots the use of a ventilation system is very important because the initial water moisture of this products is high enough, it varies between 85...90%, while the storage humidity can not be over 12...14%. To achieve this is necessary to use a very good ventilation system, to ensure the evacuation of water vapors from the drying chamber, especially because the drying temperature is relatively low and there is the risk of molding products because of the high level of humidity in the interior of drying chamber.*
Keywords: *ventilation, drying, plant product, humidity*

1. INTRODUCTION

If the products that need to be dried are very perishable, it is necessary to use during the progress of the drying process, an adequate ventilation system to increase efficiency of the process but also for obtaining a high quality product. In the paper is presented the case when the products chosen, namely tomatoes, apricots and carrots, were subjected to drying process at a temperature of 30^0C, drying being carried in a small oven, equipped with ventilation system, which flow exhaust air is constant, as can be seen in Figure 1.The capacity of this oven is 58 liters, the maximum temperature is 150^0C and can be changed from one to one degree. It also offers the possibility to read the temperature from the drying chamber and also the temperature that was set. For all the products that were used, drying is made until the product moisture is lower than 15%, and the difference between two weighs is maximum 2 g. This is very important for keeping the vitamin content and for keeping the rehydration capacity of the products.

Figure 1: Oven type LPF58

2. MATERIAL AND METHOD

When drying at a temperature of 30^0C the products used were tomatoes, carrots and apricots. The amount of product from each species was 100g, because this quantity allows a precise calculation of the amount of moisture lost by the products subject to the drying process, and the efficiency of the entire process. For carrots and apricots the amount of product was double, 200g, because that form in which they undergo drying, in the case of tomatoes, was used throughout an amount of 200g even though the form in which were dried was the slice . For oven drying was necessary to use a container for the products to be dried to prevent loss of juice and flavor mixing Relationship with which moisture product can be calculated is the following:

$$U = \frac{C - A}{B - A} \cdot 100\% \quad \textbf{(1)}$$

Where: U – the product moisture (%), A - weight of the container where the products are placed (g), B – weight of the container with the product (g), C – weight of the product after first weighing at 8 hours.
Table 1 presents the evolution of humidity for drying a quantity of 187.37 g of sliced tomatoes.

Table 1: Humidity evolution for sliced tomatoes dried at 30^0C

The initially amount of product	Hour when weighing was made	14.15 (11.07.2011)	21	7.30 (12.07.2011)	15	21	7.30 (13.07.2011)
B=195,21	The amount of product weighed (g)	C1=180,34	C2=155,46	C3=106,37	C4=79,03	C5=51,82	C6=21,70
	The product moisture (%)	92,06%	78,78%	52,58%	37,99%	23,52%	7,39%

Graphical representation of Table 1 can be seen in Figure 2:

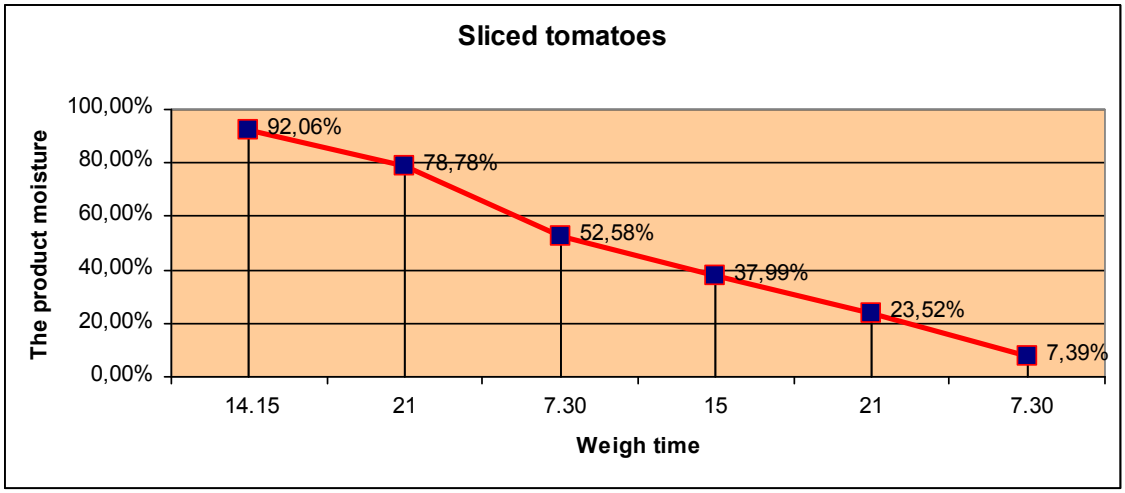

Figure 2: Humidity evolution for sliced tomatoes dried at 30^0C

As you can see from the chart shown above evolution of the product moisture is quite sharp even when the temperature was maintained constant with ventilation system is equipped with oven. This means that during the 48 hours that lasted drying, temperature was kept at 30^0C value, thus ensuring optimum humidity removal.

For carrots drying was done in parallel for the two forms in which they were cut, respectively longitudinally and transversely. The amount of product in each category was 95.78 g for carrots cut longitudinally and 99.65 g for carrots cut transversely. In table 2 are presented the evolutions of the humidity for carrots, in their two forms, dried at 30^0C.

Table2: The humidity evolution for carrots dried at 30^0C

The initially amount of product	Hour when weighing was made	14.15 (11.07.2011)	21	7.30 (12.07.2011)	15	21	7.30 (13.07.2011)
B=103,54 (longitudinally)	The amount of product weighed (g)	C1=87,1	C2=71,57	C3=28,27	C4=24,68	C5=22,76	C6=21,91
	The product moisture (%)	82,83%	66,62%	21,41%	17,66%	15,66%	14,77%
The initially amount of product	Hour when weighing was made	14.15 (11.07.2011)	21	7.30 (12.07.2011)	15	21	7.30 (13.07.2011)
B=107,45 (transversely)	The amount of product weighed (g)	C1=86,53	C2=54,07	C3=45,29	C4=26,08	C5=21,15	C6=20,26
	The product moisture (%)	76,02%	46,43%	37,62%	18,34%	13,39%	12,50%

Graphical representation of Table 2 can be seen in Figure 3:

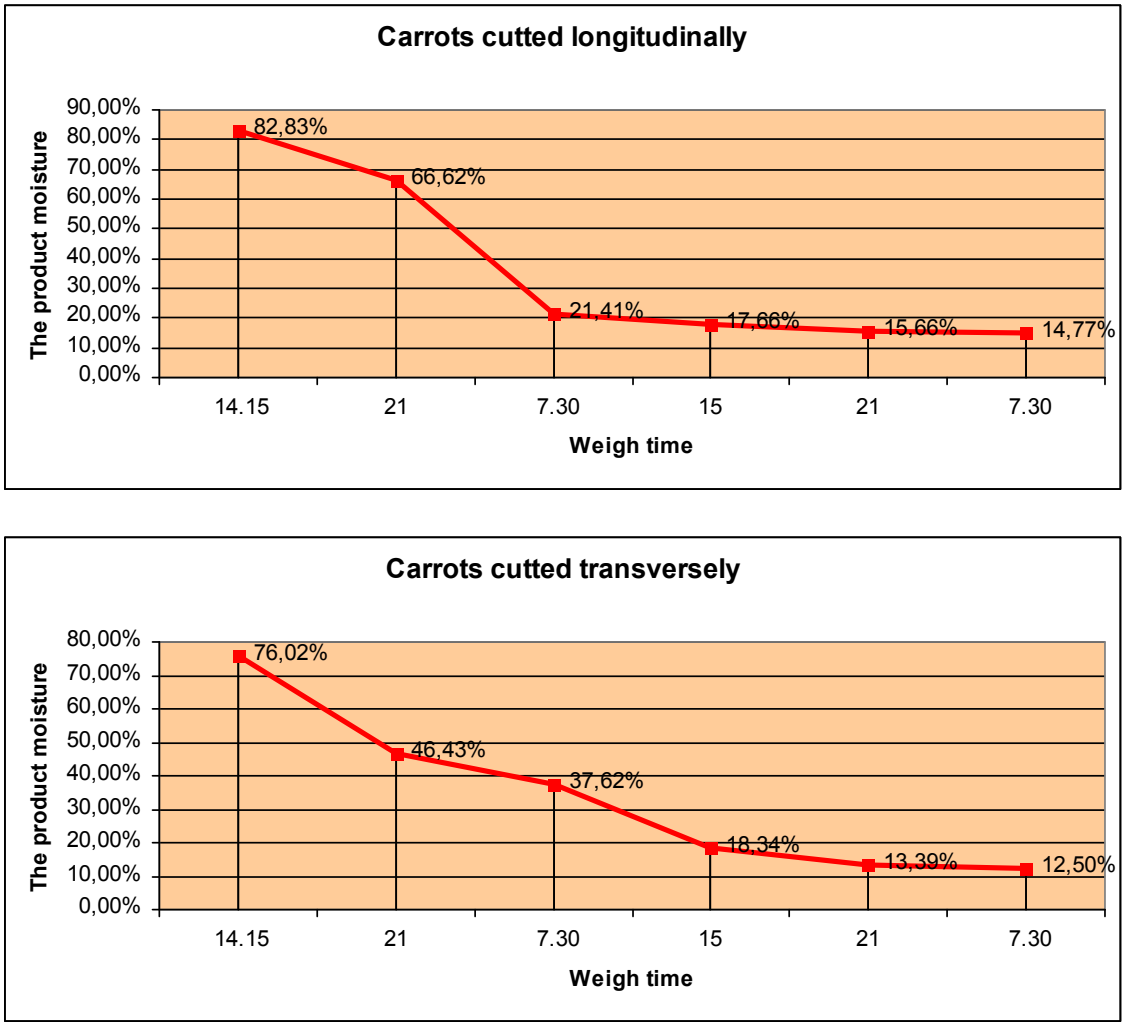

Figure 3: The humidity evolution for carrots dried at 30^0C

Thus we can see that moisture evolution has a more pronounced character for longitudinal cutting, but since the 20% value, decrease is not as pronounced in any one case. So ventilation is extremely important in early stages of the drying process when the moisture loss occurs much more intense, that when, in less than 24 hours, there is a decrease of humidity by about 50%. Thus, the ventilation system of the oven helps to eliminate the moisture excess from the drying chamber and also to keep constant the temperature.

In case of apricots, these were dried in two forms: whole with pits and slices. In case of whole apricots can be observed that during 56 hours while drying toke place, the humidity loss was pretty small, that means starting from a humidity by 98,63% it finally get to a value of 84,06% humidity. So, drying apricots in this form is not very efficient because of the high level of energy consumption. In both forms, the amount of the products was 108,36 g for whole apricots and 118,3 g for the sliced apricots. The humidity evolution during drying at 30^0C can be observed in Table 3 and graphical representation from Figure 4.

Table 3: The humidity evolution for apricots dried at 30^0C

The initially amount of product	Hour when weighing was made	14.15 (11.07. 2011)	21	7.30 (12.07. 2011)	15	21	7.30 (13.07. 2011)	14
B=116,37 (whole with pits**)**	The amount of product weighed (g)	C1=114,89	C2=113,21	C3=110,17	C4=108,19	C5=105,92	C6=101,48	C7=99,10
	The product moisture (%)	98,63%	97,08%	94,27%	92,45%	90,35%	86,25%	84,06%
The initially amount of product	Hour when weighing was made	14.15 (11.07.2011)	21	7.30 (12.07.2011)	15	21	7.30 (13.07.2011)	14
B=126,18(sliced**)**	The amount of product weighed (g)	C1=108,14	C2=89,54	C3=61,12	C4=47,61	C5=36,58	C6=27,90	C7=26,14
	The product moisture (%)	84,75%	69,02%	45%	33,58%	24,26%	16,92%	15,43%

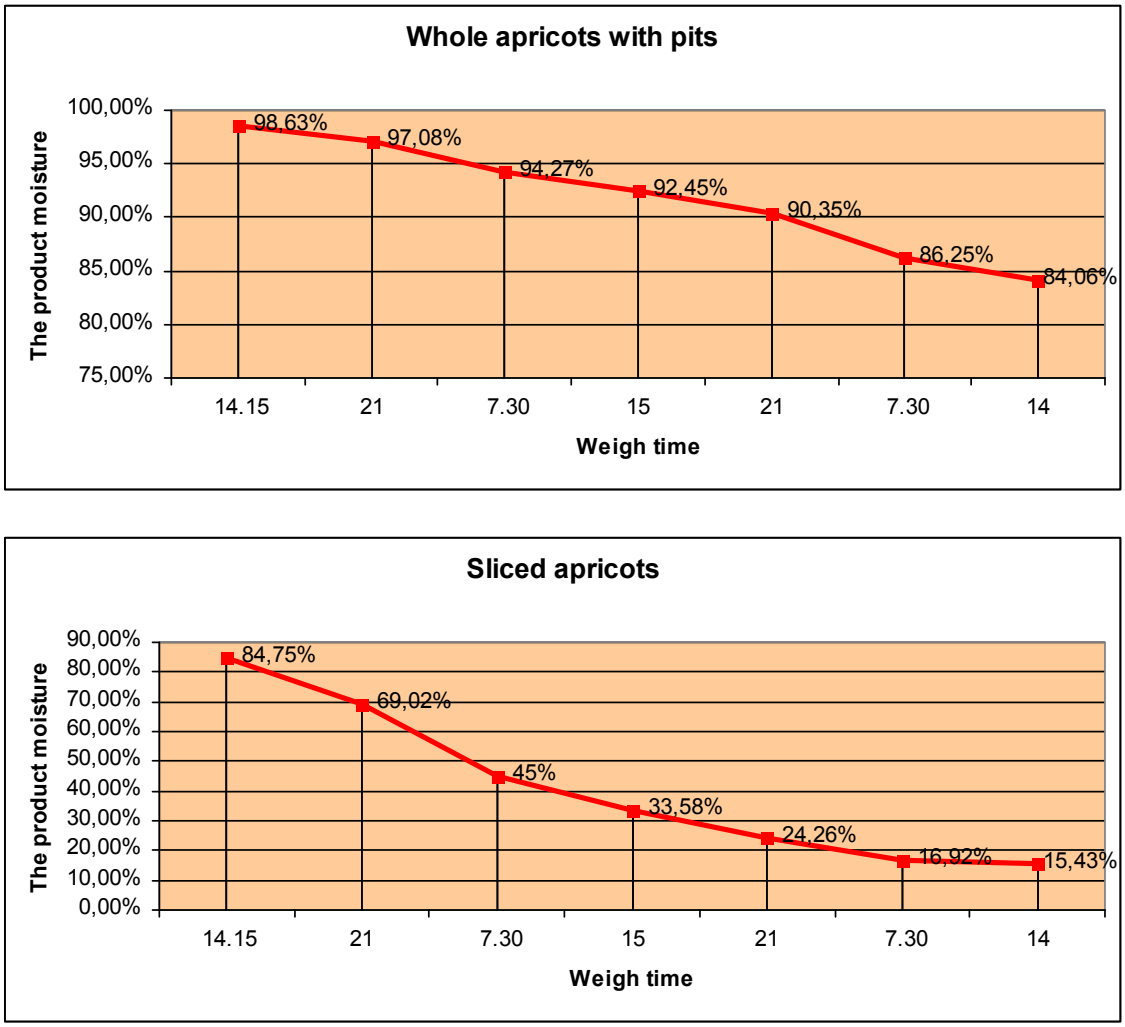

Figure 4: The humidity evolution for apricots dried at 30^0C

3. CONCLUSION

If the products that need to be dried are very perishable, it is necessary to use during the progress of the drying process, an adequate ventilation system to increase efficiency of the process but also for obtaining a high quality product.
For tomatoes, carrots and apricots the use of a ventilation system is very important because the initial water moisture of this products is high enough, it varies between 85...90%, while the storage humidity can not be over 12...14%.
To achieve a high quality product is necessary to use a very good ventilation system, to ensure the evacuation of water vapors from the drying chamber, especially because the drying temperature is relatively low and there is the risk of molding products because of the high level of humidity in the interior of drying chamber.

REFERENCES

[1] Banu, A. C. and coll, *Engineer Book for Food Industry*, vol. II, Technical Publishing Company, Bucharest, 2003
[2] Carambulea, A., Carabogdan, Gh.: *Models of actual and optimal energy balance*, Publishing House, Bucharest, 1985
[3] http://www.uscatoare.ro/ Accessed 28-09-2011

ACKNOWLEDGEMENT: *This paper is supported by the Sectoral Operational Programmer Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/88/1.5/S/59321*