IMPROVEMENT OF THE TECHNOLOGICAL SYSTEMS FOR DRYING CEREAL PRODUCTS

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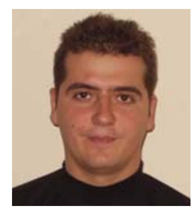

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ABSTRACT. The present paper shoes a few observations regarding the drying process through convection of the grains, using the actual storage technology, keeping the standards for quality and nutritional safety în the present context of integration în the European Union. Drying seed grain for the purpose of storage for long periods, it's a method used în food industry on a large scale, but should take into account the parameters of drying, and the process, and the process takes place without the depreciation of the quality of grain.

Keywords: storage technology, quality of grain, drying process, quality standards.

REZUMAT. Lucrarea prezintă câteva observaţii privind necesitatea optimizării proceselor de uscare prin convecţie utilizând tehnologiile de păstrare a produselor cerealiere, în contextul eficientizării activităţilor de depozitare şi păstrare a cerealelor, de aliniere la cerinţele de calitate şi siguranţă alimentară europene. Uscarea seminţelor de cereale în vederea depozitării pe perioade îndelungate este o

metodă utilizată pe scară foarte largă în agricultură şi industria alimentară, dar care trebuie să țină seama de caracteristicile parametrilor de uscare, iar procesul să se desfăşoare fără deprecierea calitativă a cerealelor.

Cuvinte cheie: tehnologii de uscare, calitatea cerealelor, proces de uscare, standarde de calitate.

1. INTRODUCTION

Cereals represent the most important feed for humans. According to FAO (Food and Agriculture Organization of the united Nations), each year over 20% of the gathered cereals are lost on a worldwide scale, the largest part is due to pest activity, development of fungus and mildew.

2. DESIGNING THE NON-LINEAR EXPERIMENTS RDS(= RESPONSE SURFACE DESIGN) TYPE

This set of experiments named factorial superior order experiments are used for the purpose :

• setting the factors for obtaining the best response;

• setting the factors that are satisfying the technical imposed conditions;

• identification of new operating conditions that are leading to improving the quality of the technological process;

• establishing the quantitative interdependencies model between factors and response.

For the experiment at which we need to find the answer – corn drying, are established the control factors and their variation, those information being presented in table 1, through the realization of 14 tests, planned according to the previous information obtained in the drying process that identified the optimum domain.

The chosen statistical programs package allowed mathematical modeling for the drying process, resulting the regression coefficients from tables 2 and 3.

It is observed an important influence that temperature has over humidity * time and temperature* temperature (interaction of 2nd order). The mathematical model is very good, it approaches the experimental data, 98% of it can be found in it.

Table 1. **Table with the values of the central – composed experiment, for corn drying**

Std Order	Run Order	Pt Type	Blocks	Drying agent temperature (°C)	Drying duration, (min)	Final humidity, (%)	Final temperature (°C)
4	1	1	1	90	60	14	27
3	2	1	1	50	60	15	28
7	3	0	1	70	45	14.5	27.5
5	4	0	1	70	45	14.6	27.6
1	5	1	1	50	30	14.7	28.7
2	6	1	1	90	30	14.2	27
6	7	0	1	70	45	14.6	28.3
11	8	-1	2	70	66	14.5	28.1
9	9	-1	2	98	45	13.8	27
12	10	0	2	70	45	14.7	28.6
14	11	0	2	70	45	14.5	28.6
13	12	0	2	70	45	14.6	28.7
8	13	-1	2	42	45	15.2	28.8
10	14	-1	2	70	24	15	29

Table 2. **Regression coefficients for corn drying, MINITAB**

Term	Coef	SE Coef	T	P
Constant	10.6230	0.862564	12.316	0.000
Block	-0.0772	0.029491	-2.618	0.034
Temperature	0.1133	0.016743	6.769	0.000
Time	0.0653	0.021076	3.097	0.017
Temp*Temp	-0.0006	0.000103	-6.278	0.000
Time*Time	0.0001	0.000183	0.532	0.611
Temp*time	-0.0012	0.000184	-6.797	0.000

Table 3. **Analysis of the variation for the final humidity**

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
Blocks	1	0.08643	0.08347	0.083466	6.86	0.034
Regression	5	4.92335	4.92335	0.984670	80.88	0.000
Liniar	2	3.86995	0.56559	0.282794	23.23	0.001
Surface	2	0.49090	0.49090	0.245451	20.16	0.001
Interacţion	1	0.56250	0.56250	0.562500	46.20	0.000
Residual error	7	0.08522	0.08522	0.012174		
Partial default	3	0.05855	0.05855	0.019518	2.93	0.163
Error	4	0.02667	0.02667	0.006667		
Total	13	5.09500				

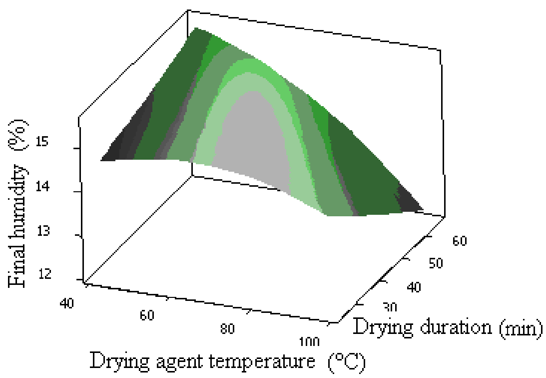

Fig. 1. Final humidity variation for cereal as a function of the drying agent temperature and the process duration.

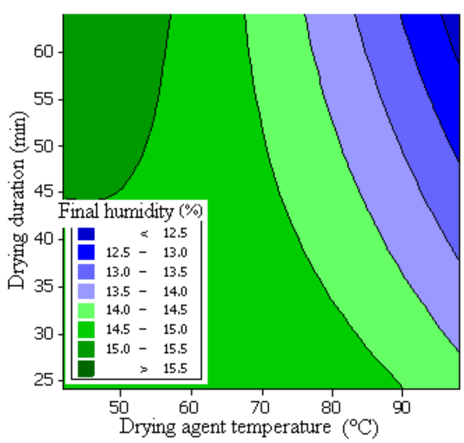

Fig. 2. The final humidity surface outline as a function of drying temperature and process duration.

The mathematical model allows tracking the influence of each control factor over the drying process. Such resulting the final humidity variation diagrams as a function of the drying agent's temperature and the duration of the process. The dependencies drying duration as a function of the drying agent's temperature (figure 1) and the level curves indicate the presence of a local optimum for this dependence.

Using the same reasoning, after running the statistical control program there were obtained the next regression coefficients estimated for the final humidity and the final temperature dependences of the corn as a function of the drying agent temperature (figure 3), and the level curves that at their turn indicate the presence of a local optimum for this dependence.

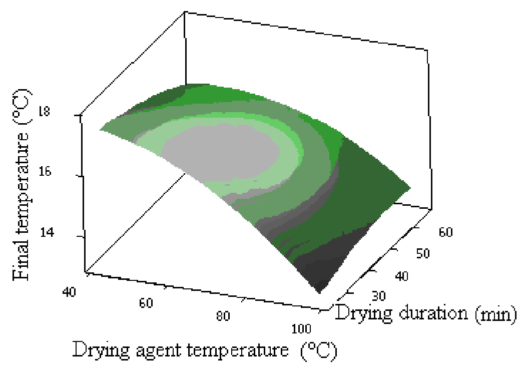

Fig.3. Final temperature surface of cereal as a function of the drying agent's temperature and the process duration.

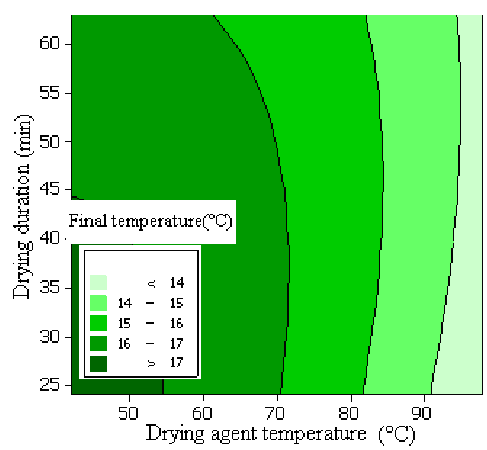

Fig. 4. The final temperature outline for cereal as a function of the drying agent's temperature and the process duration.

3. IMPROVING THE CEREAL DRYING PROCESS

So, for the chosen solution of the drying parameters, and also for the chosen mathematical model, the results are very good, following the identification for the optimum value chosen for the corn drying process.

Through superposition of the level curves for the humidity and temperature outlines of the drying agent it was possible to select the optimum domain of setting the factors for improving the drying process (fig. 5).

The obtained values after running the MINITAB program allowed obtaining the next graphical representation for the improvement of the corn drying process (fig. 6).

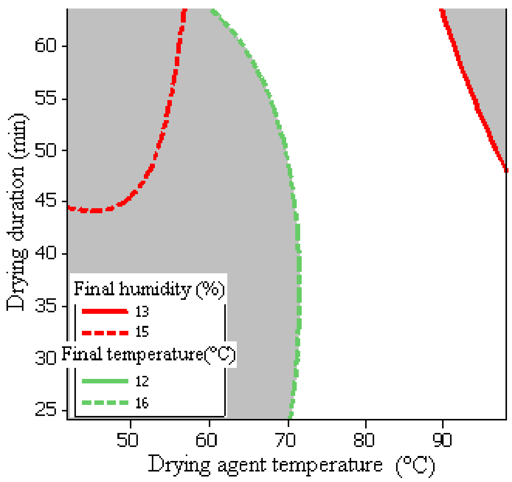

Fig. 5. Outline for the humidity surface in case of cereal, their temperature as a function of the drying agent's temperature and the process duration.

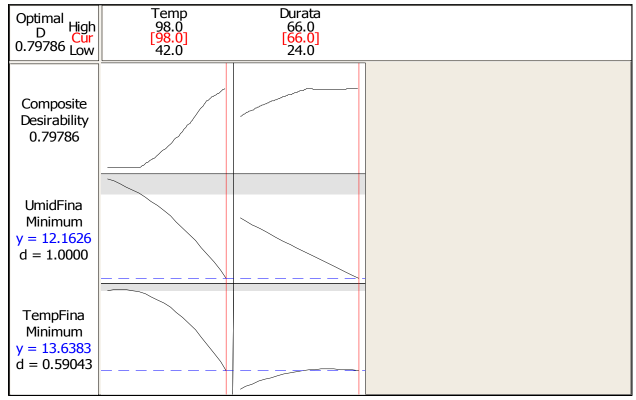

Fig. 6. The diagram of the optimum values for the corn drying parameters.

The obtained results confirm the truth of the presented technical solution in the realised research and also the fact that the technological process is found in statistic control. The controling factors that are assuring this quality are, the drying agent's temperature = 98°C and the duration of the drying process = 66 minutes. Because the improvement variables have the value (d = 1, D = 0.79), the optimum point was achieved and the normal probability distribution confirms the experimental results (fig. 7).

4. CONCLUSIONS

Being given all that was reminded earlier, the european legislation concerning food safety and assurance and not in the last place the internal regulations of the Agriculture Ministry and the Sanitary Veterinary Direction, food can represent a potential source for diseases for animals and humans, after consuming products contaminated with toxins or mildew.

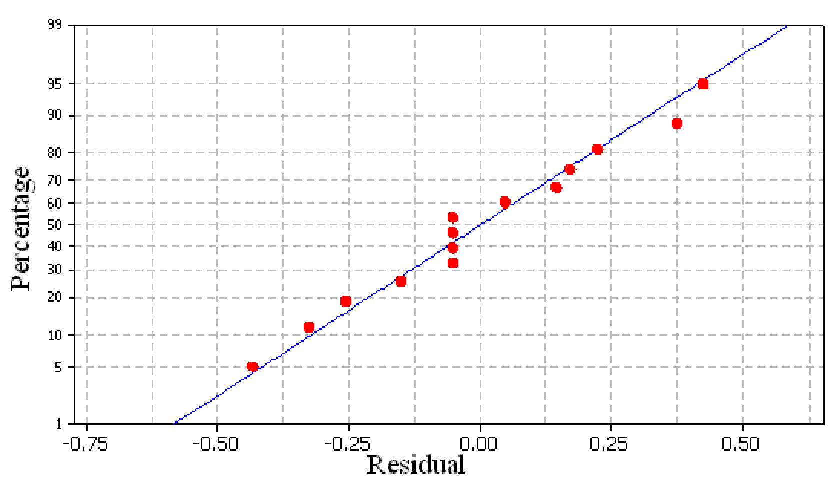

Fig. 7. The normal probability distribution of the drying process.

All of this, because of the fact that fruits, vegetables and cereal are to be consumed in a fresh state, can lead to grave situations.

For this, the applying in a complete and qualitative level of the drying and depositing technologies in the analyzed case can concur to the reduction of those unwanted effects with a large impact over the population.

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