RESEARCH REGARDING THE INFLUENCE OF DRYING TECHNOLOGICAL PARAMETERS ON THE QUALITY OF WHEAT SEEDS

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Abstract: The drying process for wheat seeds ensures optimal conditions for storage and stops microbiological processes. However, the drying technological parameters must be chosen so that the protein and gluten content of wheat seeds should not be affected. Research were made and it was showed that wheat protein was significantly affected by electrohydrodynamic drying (EHD) and upon both spray and freeze-drying, glutenins changed into smaller molecular weight polymeric proteins. The purpose of this study is to determine the optimal operating parameters of the drying process to minimize the loss of protein and gluten content. In order to improve the drying process, a drying unit was designed and built and wheat seeds with humidities between 15-21 % were subjected successively to be dried. The results of the experimental researches highlight a decrease of up to 18,49 % for the protein content and a decrease of up to 36,92 % for the gluten content.

Keywords: drying, wheat, protein, gluten content

Introduction

The seeds of agricultural plants, which are subjected to the technological drying operation, behave differently depending on their structure and composition.

Therefore, some of them do not support aggressive drying conditions characterized by non-uniform temperatures and rates of the hot air when passing through the product layer. Wheat quality is a concept difficult to define because its uses are many and each user requires specific technological characteristics for the wheat grain.

In the past, efforts have been made to experimentally study the drying process of wheat seed. So far, studies have been focused on the analysis of fluidized bed drying process, microwave-assisted foam drying, and extractability of salt-soluble protein.

During the drying process, the heat is brought into the product layer by means of hot air (convection). Water vapor produced are taken out of the air, which is the mass transfer medium. Once the heat penetrates the grain mass, the mass transfer (water) starts inside the product to its surface. The water can easily reach the surface of the product or product easily occurs the phenomenon of evaporation

The purpose of this paper is to establish optimal operating parameters for the drying process, to maximize the technological effect, namely to minimize the loss of protein and gluten content, because gluten elasticity and resistance affect the rheological characteristics of bread dough and the bread (volume, aspect, core porosity and elasticity).

Materials and methods

The experiments of drying wheat seeds were conducted in the Department of Agricultural Mechanization of the University of Agricultural Sciences and Veterinary

Medicine "Ion Ionescu de la Brad", Iași, Romania, using a laboratory drying unit (***fig. 1***) for agricultural products. It allows control and monitoring of the drying process parameters that can be chosen by the user before or during the drying process.

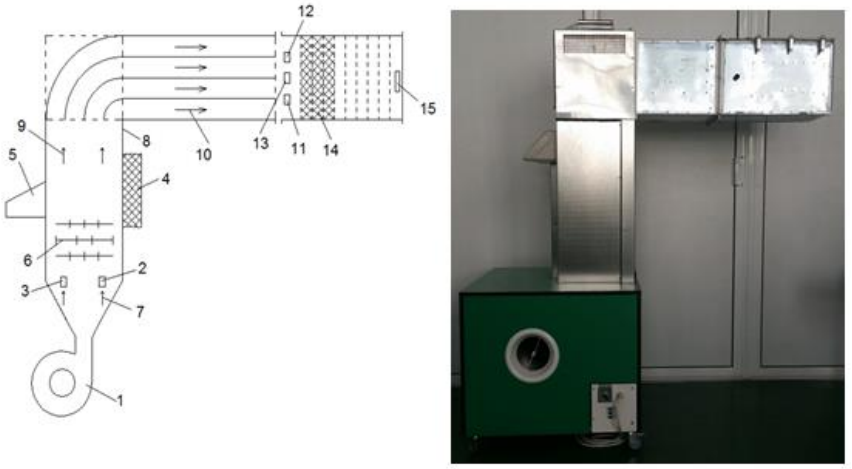

Fig. 1. Drying unit layout: 1 – fan; 2 – temperature sensor; 3 – speed sensor; 4 – isolating layer; 5 – control panel; 6 – electrical resistance; 7 – cold air; 8 – body; 9 – hot air; 10 – hot air; 11 – temperature sensor; 12 – humidity sensor; 13 – velocity sensor; 14 – drying cells; 15 – moisture sensor for the used air.

The box for cereal seed dehydration is presented in ***fig. 2***. It consists of eight cells (50 mm wide each) which are delimited by nine stainless steel sieves. The humidity of the hot air is monitored using moisture sensors mounted before and after the cereal layer.

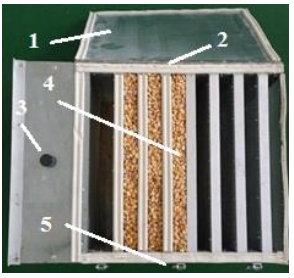

Fig. 2. Cereal seed drying box: 1 – cover; 2 – seals; 3 – hole for introducing measuring probes; 4 – drying cells separated by steel sieves; 5 – sealing cap system.

In order to achieve those proposed were subjected successively wheat seeds to be dried with 21, 19, 17 and 15 % moisture content in the three adjoining cells with a total thickness of 150 mm.

By varying the velocity and temperature of the hot air between 1 and 2.5 m/s and between 40 and 80 °C were studied a total of 20 experimental variants for each initial moisture content.

Results and discussion

In ***table 1*** are presented the results regarding the protein content of wheat seeds.

Table 1 Results regarding the wheat seeds quality parameters (protein)

Air velocity (m/s)	Air temperature (°C)	Protein content (%)			
		Initial moisture content			
		21%	19%	17%	15 %
Witness value		**12.56**	**12.98**	**12.98**	**12.92**
1	**40**	12.57	12.9	12.89	12.93
	50	12.55	12.80	12.85	12.91
	60	11.94	12.24	12.23	12.28
	70	11.67	12.00	11.95	12.00
	80	10.33	10.60	10.58	10.63
1.5	**40**	12.56	12.78	12.89	12.92
	50	12.56	12.75	12.86	12.92
	60	12.32	12.51	12.61	12.67
	70	11.74	12.02	12.02	12.08
	80	10.68	10.83	10.94	10.99
2	**40**	12.55	12.74	12.85	12.91
	50	12.57	12.78	12.87	12.93
	60	12.35	12.55	12.65	12.70
	70	11.83	12.11	12.11	12.17
	80	10.79	11.05	11.05	11.10
2.5	**40**	12.54	12.90	12.92	12.90
	50	12.50	12.70	12.80	12.86
	60	12.44	12.71	12.74	12.80
	70	11.95	12.30	12.24	12.29
	80	11.20	11.54	11.47	11.52

As a result of the conducted experiments it was observed that the protein content of wheat seeds was changed. At temperatures of the hot air higher than 50 °C, the protein content recorded slightly lower values compared to the control ones. These values have increased with increasing the air's velocity. The most affected values of the protein content were obtained for the temperature of the air of 80 °C and the velocity of 1 m/s.

The values regarding the gluten content of wheat seeds after the drying process are presented in ***table 2***.

Table 2 Results regarding the wheat seeds quality parameters (gluten)

Air velocity (m/s)	Air temperature (°C)	Gluten content (%)			
		Initial moisture content			
		21%	19%	17%	15 %
Witness value		**25.1**	**26.0**	**26.2**	**26.3**
1	**40**	24.8	25.8	26.1	26.1
	50	25.3	26.4	26.0	26.1
	60	21.1	22.0	22.1	22.2
	70	19.4	20.2	20.1	20.3
	80	16.0	16.7	16.8	17.0
1.5	**40**	24.9	26.0	26.0	26.1
	50	25.0	26.0	25.9	26.1
	60	21.0	21.9	22.0	22.0
	70	19.9	20.7	20.6	20.7
	80	15.8	16.5	16.4	16.5
2	**40**	25.1	26.2	26.0	26.3
	50	24.9	24.7	25.8	25.9
	60	21.2	22.1	22.2	22.4
	70	19.5	20.3	20.4	20.4
	80	16.0	16.7	16.6	16.7
2.5	**40**	25.0	26.0	26.1	26.0
	50	25.4	26.1	26.0	26.0
	60	21.4	22.3	22.3	22.4
	70	19.0	19.8	19.8	19.8
	80	15.8	16.5	16.7	16.7

As the wheat seeds were harvested successive starting at the humidity of 21 %, the protein content increased with the decrease of the moisture content. Similar to the protein, the witness values for gluten increased with the advance of the ripeness state between 21 % and 15 % humidity, which is normal according to wheat physiology.

The lowest values for protein were obtained for the air temperature of 80 °C and the velocities of 1.5 and 2.5 m/s.

Despite the initial moisture content of the wheat seeds, the gluten content was affected starting with the temperature of the air of 60 °C.

As shown in ***fig.3***, the losses recorded for the protein content are very high for temperatures of the air greater than 50 °C.

It can also be observed that for the wheat seeds with the initial moisture content of 15 %, the losses of protein were greater than the ones for the other initial humidities.

Not like the gluten, the protein content was less affected by higher air velocities, according to the graphic below. This happened because by higher air velocities, the layer porosity decreases which makes the temperature to go downwards.

The maximum loss of protein was 18.49 % and it was recorded for the wheat seeds with 17 % initial moisture content, which were dried at the air velocity of 1 m/s and the temperature of 80 ºC.

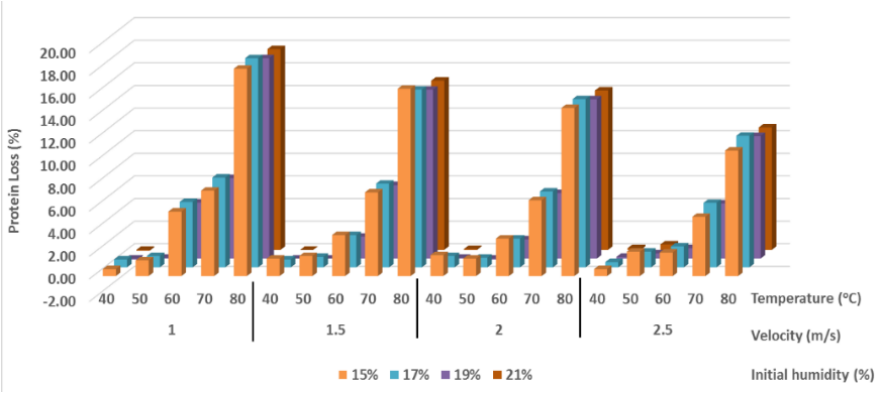

Fig. 3. The loss of protein content after drying

The ***fig. 4*** highlights the loss of gluten content of wheat seeds after drying for all four initial moisture contents. The highest loss of gluten content was recorded for the velocity of the hot air of 1,5 m/s at the temperature of 80 °C.

Gluten content decreases and the deformation index of gluten increases starting from the air temperature of 60 ºC. It was found that the decrease of the gluten content is reduced with the increase of the air velocity.

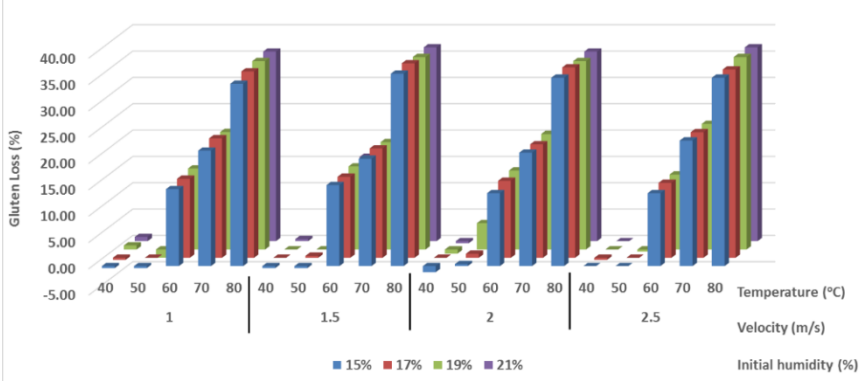

Fig. 4. The loss of gluten content after drying

Conclusions

The designed drying unit allows control and monitoring of the drying process technological parameters in order to keep the seed quality.

By varying the velocity and temperature of the hot air between 1 and 2.5 m/s and between 40 and 80 °C were studied a total of 20 experimental variants for each initial moisture content.

The results of the experimental researches highlight a decrease of up to 18,49 % for the protein content and a decrease of up to 36,92 % for the gluten content.

Wheat seeds should be artificially dried by temperatures lower than 55 ºC so that the protein and gluten qualities won't be affected.

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