RESEARCH REGARDING THE INFLUENCE OF HYDROTHERMAL PROCESSING ON THE WHEAT MILLING PROCESS AND ON THE QUALITY OF FLOUR

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***Abstract*:** The study is explaining the way in which the hydrothermal processing of wheat is influencing the technological characteristics of the wheat berries and the baking quality of the resulting flour. Also there were established the correlations between the manners of conditioning and the degree of flour extraction, the specific power consumption and the quality of the products and of the sub-products resulting after the milling process.

***Keywords*:** water, wheat, conditioning, technological characteristics, flour.

1. INTRODUCTION

The purpose of hydrothermal processing of wheat (PHT) in the process of wheat preparation before milling in the cleaning-conditioning sections is to modify correctly and in the desired direction the technological properties of wheat berries. PHT (hydrothermal processing) – represents the artificial operation on the wheat berries with water or with water and heat followed by a rest period. Given that in the mills there are processed cereals with different physical, chemical and technological characteristics it is necessary to ensure a stable quality of the processed cereals in order to obtain superior quality flour. For this the conditioning of wheat by means of PHT and rest occupies a predominant place as regards to the efficiency of using cereals in the processing.

2. THEORITICAL CONSIDERATION REGARDING THE INFLUENCE OF CONDITIONING METHODS ON THE MODIFICATION OF WHEAT TEHNOLOGICAL CHARACTERISTICS

In the present there are known the following conditioning methods: cold, hot, fast, with infrared and ultraviolet radiations, by magnetic activation of water and cyclical processing of wheat berries with the use of high and low temperatures. The basic factors which influence the efficiency of the conditioning methods of the wheat berries of different qualities are: humidity, processing period, temperature, environmental conditions and the rest period. The conditioning of wheat is peculiarly influencing the structural and mechanical characteristics of wheat berries, the milling characteristics of wheat berries and the bakery characteristics of the resulting flours.

The basic indexes which characterize the structural and mechanical characteristics of the wheat berries are: resistance, hardness and the indexes of the rheological characteristics.

The resistance of a wheat berry during milling is a basic index characteristic for it at grounding expressed by the power consumption and the degree of grinding. The milling characteristics of wheat berries are characterized by the extraction and the quality of intermediary products from the first gristing passages. The modification of the

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milling characteristics of wheat by means of conditioning is connected to the loosening of the endosperm pursuant to the intensive internal transfer of water during the rest.

The rest period and the degree of moistening depend on the variety of wheat (with a glassy and floury consistence) and influence the extraction and the quality of intermediary products from the gristing passages [1 - 3].

3. THE TECHNICAL BASE TO PERFORM THE WHEAT PROCESSING AND HYDROTHERMALLY DETERMINE THE TEHNOLOGICAL CHARACTERISTICS OF WHEAT BERRIES

For the experimental determinations regarding the influence of hydrothermal processing on the modification of the technological characteristics of wheat berries were used, as a technical base, the equipments in the technological scheme of wheat berries preparation before milling in the cleaning-conditioning section of the wheat mill of Roman. The physical-chemical examinations of wheat were performed in the mill's test laboratory, and for the finite products in the accredited laboratory of the bread and bakery products factory. The high quality of the technological equipments in the cleaning-conditioning section enabled a complex research and a comparison of the influence of different methods of hydrothermal processing on the milling characteristics of wheat berries and on the bakery characteristics of flour. The cold conditioning in the cleaning section is achieved in two manners; the first one uses three stages of wheat berries moistening and rest, the first two are basic stages and the third stage is the final one. This option allows different moistening of wheat berries depending on the initial humidity and quality and is efficient for the conditioning of high glassiness and low humidity wheat since only the moistening stage cannot provide the humidity level necessary for the wheat berries in grist I. According to the second manner the conditioning is achieved in two stages of wheat berries moistening and rest [4].

4. EXPERIMENTAL

The experimental determinations were performed for each manner of hydrothermal processing of wheat berries. By means of measures and laboratory tests were determined the milling characteristics of wheat berries, expressed by extraction of flour, the quality of intermediary products from the grist passages, the quality of the obtained flour and the specific power consumption per ton of milled wheat. By choosing the optimum rest period for the wheat with hard and soft berries was researched the influence of humidity in grist one on the extraction and the ashes of semolina, dunst and flour obtained in grist I ….grist IV.

The experimental data is presented in the tables. In Table 1 are presented the experimental data referring to the extraction of intermediary products according to the humidity and the rest period of the wheat berries with a medium glassiness of 68%.

Table 1. The experimental data referring to the extraction of intermediary products according to the humidity and the rest period of the wheat berries with a medium glassiness of 68%.

Initial humidity of wheat [%]	Final humidity of berries at Gr.I [%]	Rest time (hours)	Extraction [%]			Total of intermediary products [%]
			Large semolina from GrI ..GrIV [%]	Medium and small semolina from GrI..GrIV [%]	Dunst from GrI..Gr.IV [%]	
12.5	12.3	-	42.00	20.00	9.0	72.0
12.5	14.5	6	38.50	22.50	12.5	73.5
12.5	15.5	10	36.00	24.00	14.0	74.0
12.5	16.5	12	32.50	26.50	16.7	75.7

From the presented experimental data one can conclude that along with the increase of the humidity action on the berry the structure of the endosperm is destroyed and this is reducing the extraction of large and medium semolina and is increasing the quantity of small semolina and of dunst. The modification of the percentage of

other production fractions begins after 3.5 – 4.5 hours of rest, namely when the water began passing in the superficial layers of the endosperm and stops after 10 – 12 hours of rest, after which the extraction of the other products is no longer modified. In Table 2 are presented the experimental data regarding the extraction of intermediary products when milling the soft wheat with a medium glassiness of 45%.

Table 2. The experimental data regarding the extraction of intermediary products when milling the soft wheat with a medium glassiness of 45%.

Initial wheat humidity [%]	Final humidity of Wheat berries at Gr.I [%]	Rest period (hours)	Extraction [%]			Total of intermediary product [%]
			Large semolina from GrI ..GrIV [%]	Medium and small semolina from GrI..GrIV [%]	Dunst from GrI..Gr.IV [%]	
12.5	12.3	-	38.00	23.00	10.0	71.0
12.5	14.5	6	36.50	24.80	11.7	73.0
12.5	15.5	8	34.00	26.20	14.0	74.2
12.5	16.5	10	30.50	28.50	16.5	75.5

It can be observed that when conditioning the soft wheat (45% glassiness) and the duration of rest of (6…10 hours), the extraction of large semolina diminishes with 4%, the quantity of medium and small semolina increases with 3%, the quantity of dunst increases with 1% and the extraction of flour increases with 2%. In Table 3 there are presented the experimental data regarding the influence of wheat conditioning methods on the modification of the characteristics of wheat milling and on the quality of intermediary and finite products.

Table 3. The experimental data regarding the influence of wheat conditioning methods on the modification of the characteristics of wheat milling and on the quality of intermediary and finite products.

Conditioning methods	Wheat humidity in Gr.I [%]	Extraction and quality of intermediary and finite products				
		Large semolina [%]	Ash of large semolina [%]	Mean of ash in interm. products [%]	Flour ash [%]	Total extraction of [%]
0.	1.	2.	3.	4.	5.	6.
Wheat with a glassiness of 6 8 %						
Cold conditioning	15.5	36.0	1.25	0.90	0.65	74.5
Hot circumanience conditioning	16.0	35.1	1.19	0.87	0.63	75.2
Wheat with a glassiness of 4 5 %						
Cold conditioning	15.3	34.0	1.15	0.88	0.64	74.2
Hot circumanience conditioning	16.1	35.5	1.05	0.82	0.62	75.1

It can be observed that in case of cold conditioning when the water temperature is not higher than 20°C the quantity of large semolina and the content of ash increases as compared to hot conditioning. Also the total extraction of flour increases significantly, the ash decreases in case of hot conditioning as compared to cold conditioning, a tendency manifested also for the wheat with a glassiness of more than 68%. In Table 4 is presented the experimental data regarding the influence of conditioning on the specific power consumption per ton of milled wheat.

For a humidity of 12.5%...12.8% of the unconditioned wheat with a dry layer the wheat berries have the appearance of some shivery and elastic elements which at a certain dynamic load on the roll break with a reduced power consumption as compared to the hot and cold conditioned wheat berries when the humidity is of 15.8% …16.5%. This phenomenon is explained by the fact that the wheat berry is acting as an elastic element so that it increases the grinding power.

Table 4. The experimental data regarding the influence of conditioning on the specific power consumption per ton of milled wheat.

Conditioning method	Power consumption (kw/tone of milled wheat)	Glassiness [%]	Humidity on Grist I [%]
Unconditioned wheat	102 (86)	45	12.5
	108 (88)	68	12.8
Cold conditioned wheat	88 (89.4)	45	15.8
	94 (94)	68	
Hot conditioned wheat	86 (102)	45	16.5
	88 (108)	68	

5. CONCLUSIONS

Based on the experimental determinations the following conclusions can be drawn:
- Along with increasing the action of humidity on the wheat berry, the structure of the endosperm is destroyed and results in reducing the extraction of large and medium semolina and increasing the quantity of small semolina and of dunst;
- The modification of the percentage of other production fractions begins only after 3.5 – 4.5 hours of rest, namely when the water began passing in the superficial layers of the endosperm and stops after 8 – 10 hours when the extraction of other products is no longer modified;
- The rest period and the moistening degree on the varieties of wheat with a glassy and floury consistency of more than 68% influences the extraction and the quality of intermediary products from grist I ... grist IV;
- Along with increasing the rest period from 4 to 24 hours, the extraction of large semolina from the wheat with a glassiness of more than 68% was reduced with 2.5% and the flour extraction was increased with 1.5%;
- From the cold conditioned wheat berries result larger semolina than from the hot conditioned wheat berries from which result smaller semolina due to the loosening of the endosperm;
- The quality of the flour with an extraction of 75.7% certifies the technological efficiency of hot conditioning, a method which allows uniform moistening of the marginal areas of wheat berries;
- The specific power consumption is lower when milling the cold conditioned wheat berries with a small glassiness (group III of glassiness) and increases when milling the hot conditioned high glassiness berries (group I of glassiness);
- The arrangement adopted by PHT can adjust the release of some biochemical processes in the wheat berry which are accompanied by quantitative and qualitative modifications of gluten and of the baking quality of flour;
- The optimum humidity of wheat berries in grist I must be of 16% - 16.5%;
- The optimum rest period is practically established by means of experimental determinations based on glassiness and the conditioning method.

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