MODIFICATIONS OF SOME DOUGH RHEOLOGICAL DESCRIPTORS THROUGH THE ADDITION OF VEGETAL FIBRES WITH FUNCTIONAL PROPERTIES

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Abstract

We intend to highlight in this field the effect of inulin addition upon the main dough rheological descriptors: we tested the Fibrulin Instant commercial mixture, commercialized by the Enzymes & Derivates company in Piatra Neamt).For this purpose, we used two types of unimproved flours (type 480 and type 650), derived from Romanian wheat, the crop of the year 2006, processed by S.C. Farinsan S.A. company, Grădiştea, Giurgiu district. Tests were conducted to monitor the modifications of the following parameters: the falling number, farinographic and alveographic parameters, after addition of various quantities of different quantities of Fibruline Instant. We also made baking tests for the control variant (unimproved), respectively the variants with 1.5 % and 3 % inulin. Our results highlighted that the adding of conditioner does not influence significantly the alveographic parameters of dough, up to 3% admixture. The inulin addition caused the significant decrease of the hydration capacity of dough, with a proportion depending on the added dose of inulin. Additionally, the Stability parameter obviously increased in the inulin added flours with respect to the control flours, no matter what their type of extraction. In respect of the bread quality, we noticed a come-down tendency of the porosity parameter when the added inulin quantity increases.
***Key words**: Wheat flour, inulin, rheology, functional products*

Introduction

Vegetal fibres represent a very important category of food additives, from the point of view of nutritional and functional effects they produce in the human organism. But the addition of fibres in flour is also associated with certain modifications of its technological parameters which influence directly the quality of the end products (*Bordei, 2000*).One of the most important ingredients, preconized to be used to obtain the bakery products

with functional properties is inulin. It is a polymer mainly constituted of fructose units and a terminal glucose unit. The fructose units are related by β-2,1-glycosidic bonds and can be between 2 and 140 (*Tamba-Berehoiu, 2002*). The most prevalent inulin source is represented by the chicory (*Chichorium intybus*) tuberized roots. The most important functional effects of inulin are related to its resistance to hydrolysis on the whole digestive way excepting the colon, where it is hydrolysed by the specific microflora (*Popa, 2007*). The main physiological effects of inulin are: inulin amends the absorbtion of calcium and magnesium, improves the probiotic bacteria activity; it stimulates the increase of intestinal bifidobacteria (*Popa, 2007*) and exerts a minimum impact upon the blood sugar (it can be used by diabetical people) etc.The importance of adding inulin to bread is due to the fact that because of the large number of consumers of bakery products, many people can benefit of the nutritional qualities of inulin, ignoring certain criteria as: age, sex, etc. In our research we examined the way the inulin (a hydrosoluble vegetal fiber) and its addition influences the technological qualities of some flour samples and implicitly the quality of the end product. We studied:

- the influence of inulin addition upon the alveographic characteristics of dough obtained from wheat flour;
- the influence of inulin addition upon the farinographic characteristics of dough obtained from wheat flour;
- the influence of inulin addition upon the falling number of dough obtained from wheat flour;
- the influence of inulin addition upon the quality of the bread obtained from wheat flour.

Experimental

In order to achieve the experiments, we used two types of unimproved flours (type 480 and type 650), derived from Romanian wheat, the crop of the year 2006, processed by S.C. Farinsan S.A. company, Grădiştea, Giurgiu district, and a functional ingredient, Fibruline Instant (pure inulin), commercialized on the Romanian market by the Enzymes & Derivates company in Piatra Neamţ. The flours were added different quantities of Fibruline Instant (not disolved in water before adding), according to the experimental scheme presented in table 1, and were tested concerning the evolution of the farinographic parameters (the method described by the ICC-Standard No. 115/1), the alveographic parameters (the

method described by the ICC-Standard No. 121), the falling number parameters (according to SR ISO 3093 [1997]), respectively by achieving a baking test (according to the method described in table 1,2).

Table 1: The experimental scheme of the investigation

FLOUR TYPE	VARIANTS OF ADDITIVATION	TESTS
FLOUR TYPE 480	Control	alveogram; falling number; farinogram; baking test
	1.5 % Fibruline Instant	alveogram; cifra de cadere; farinogram; baking test
	3.0 % Fibruline Instant	alveogram; falling number; baking test
	4.5 % Fibruline Instant	alveogram; falling number; farinogram
	7.0 % Fibruline Instant	alveogram; falling number
FLOUR TYPE 650	Control	Falling number, Farinogram
	2.0 % Fibruline Instant	Falling number
	4.0 % Fibruline Instant	Falling number
	7.0 % Fibruline Instant	Farinogram
	8.0 % Fibruline Instant	Falling number

Table 2: The recipes and technological parameters for achieving the baking tests

INGREDIENTS	CONTROL	CONTROL + 1.5% FIBRULINE INSTANT	CONTROL + 3 % FIBRULINE INSTANT
	Quantity (g)		
Water	1100	1100	1100
Flour	2000	2000	2000
Yeast	100	100	100
Iodate salt	40	40	40
Margarine	40	40	40
Fibruline instant	0	30	60
TECHNOLOGIC PARAMETERS			
KNEADING	V1 = 5 min V2 = 8 min T ^{0}C dough = 27,6	V1 = 5 min V2 = 8 min T ^{0}C dough = 28.2	V1 = 5 min V2 = 8 min T ^{0}C dough = 28.8
FERMENTING	15 min, 240 C		
DIVIZATION	750 g		
FERMENTING	50 min, 360 ^{0}C, 80 % humidity		
BAKING	In trays, at 230/2350 ^{0}C, 41 min		

Results and Discutions

Our results, regarding the alveographic parameters of the dough obtained from the control flour, and the inulin added flours, are shown in table 3.

Table 3: Analitical rheological values value for flour improved with different quantities of Fibruline Instant

VARIANT	PARAMETERS					
	P (mm H2O)	L (mm)	G	W (E-4J)	P/L	Ie (%)
Control	76	85	20.5	225	0.89	57.3
I (1.5 % inulin)	73	86	20.6	218	0.85	57.1
II (3 % inulin)	75	66	18.1	192	1.14	59.5
III (4.5 % inulin)	64	69	18.5	173	0.93	61.3
IV (7 % inulin)	57	32	12.6	84	1.78	0

As seen in table 3, the used control flour can be described having normal baking characteristics, with an optimum P/L ratio for obtaining bread, and the value of the parameter W (kneading energy absorbed by dough) is comparable to the values specified in literature.

The addition of an inulin based conditioner does not influence significantly dough resistance, up to 3% (Variants I and II), the decrease of this parameter being insignificantly (figure 1).

Over this limit, dough resistance begins to decrease significantly, reaching the 16 % threshold for 4.5 % Fibruline Instant addition (Variant III) and 25 % for 4.5 % Fibruline Instant addition (Variant IV).

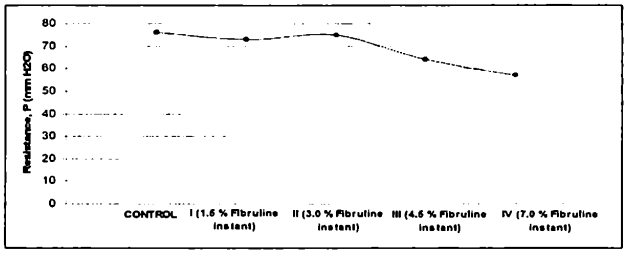


Fig. 1: The effect of adding the inulin based conditioner, on the Resistance (P) alveographic parameter of dough

As regards the Extensibility parameter, we noticed a similar effect; small inulin doses did not influence significantly the value of the parameter. For big doses the value of dough extensibility can decrese even with 60% in comparison with the starting value (figure 2).

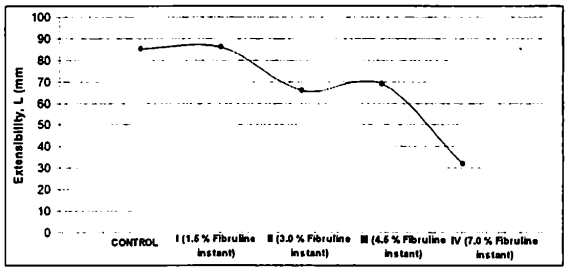


Fig. 2: The effect of adding the inulin based conditioner on the Extensibility (L) alveographic parameter of dough

As seen in figure 3, the value of W parameter decreases, as the quantity of added conditioner increases.

The decrease of W parameter is less significant for the previous two used variants, and becomes evident for the variants III and IV.

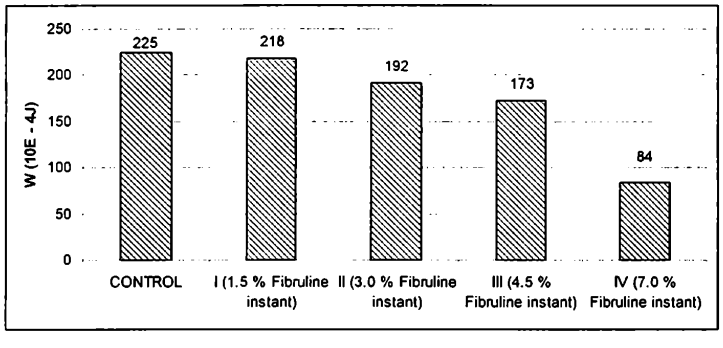


Fig. 3: The effect of adding the inulin based conditioner on the W alveographic parameter of dough

As regards the influence of adding the inulin based conditioner on the Falling number parameter, the results are presented in table 4.

Table 4: The effects of adding Fibruline Instant on the Falling Number parameter of flour

FLOUR TYPE	VARIANTS OF CONDITIONINGS, (%)							
	0 (control)	1.5	2.0	3.0	4.0	4.5	7.0	8.0
Flour type 480	425 (sec)	474 (sec)	-	462 (sec)	-	481 (sec)	502 (sec)	-
Flour type 650	345 (sec)	-	334 (sec)	-	328 (sec)	-	-	350 (sec)

As seen in table 4, the control flour type 480, used in our investigations, has been characterized by a relative small diastasic activity (big falling number).

The diastasic activity has been higher for the flour type 650 than for the flour type 480, the falling number being smaller.

The addition of inulin determined a significant modification of the diastasic activity of the flour type 480, the general tendency being a decrease of the diastasic activity, respectively an increase of the value of the Falling Number parameter. We notice that diastasic activity decreases as the quantity of inulin increases.

As for the flour type 650, the results were less convincing, as we registered less significant differences between the variants.

The results obtained from the farinografic tests are presented in table 5.

Table 5: The results obtained from the farinografic tests for the 480 and 650 control flours, respectively for the variants with different addition of inulin based conditioner

FLOUR TYPE	VARIANTS	FARINOGRAPHIC TESTED PARAMETERS			
		Hydration capacity (%)	Developing time (min)	Stability (min)	Softening (UF)
480	***Control***	57.9	2.9	36.8	11
	1,5 % Inulin	55.9	29.2	39.6	8
	4,5 % Inulin	52.1	23.7	43.2	5
650	***Control***	60.0	1.8	3.3	68
	7,5 % Inulin	46.6	1.7	27.7	28

As seen in table 4, the two types of control flour showed very significant differences, regarding their rheologic behaviour.

So, the flour type 480 can be characterized as a strong flour, with high stability and very low dough softening degree, while the flour type 650 is a weak flour, with little stability and a relative high softening degree for dough.The inulin addition caused a significant capacity of hydration of dough, a percentage being dependent on the added inulin quantity (fig.4).

The Stability parameter of dough obviously increased for the inulin added flours with respect to the control flours, no matter what their type of extraction (fig. 5).

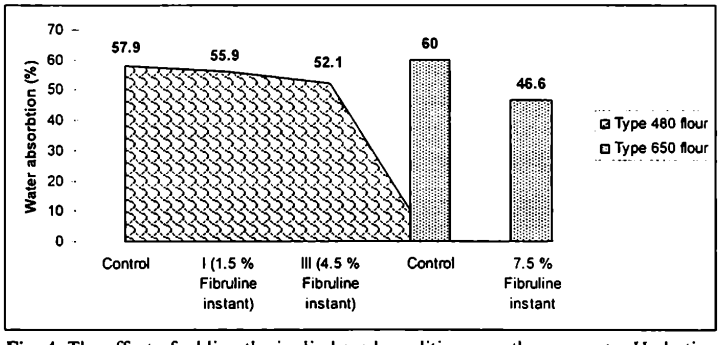


Fig. 4: The effect of adding the inulin based conditioner on the parameter Hydration Capacity, for the flours type 480, respectively 650 that have been used

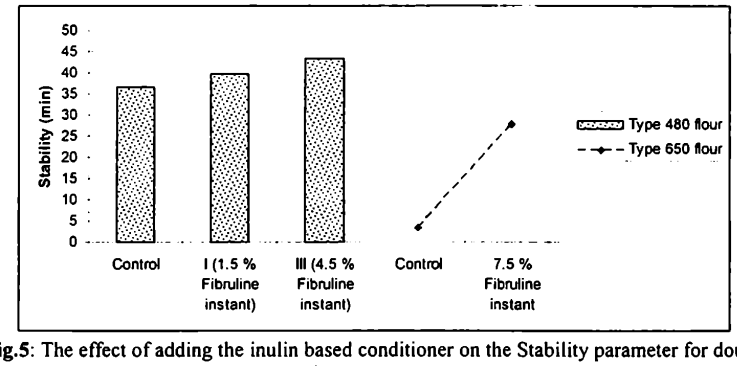


Fig.5: The effect of adding the inulin based conditioner on the Stability parameter for dough derived from the flours type 480, respectively 650

The increase of the parameter Stability has been smaller for the flour type 480, being maximum 17.4 % for the variant with 4.5 % added conditioner.

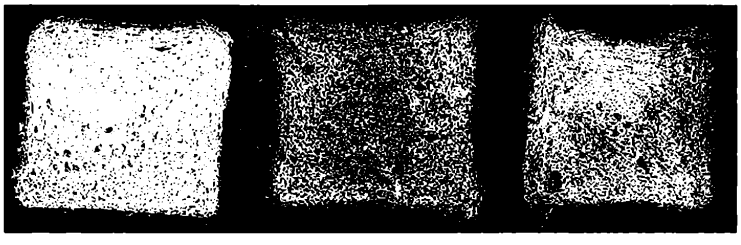
For the flour type 650, the increase of the parameter Stability has been spectacular, as it grew 9 times with respect to the initial value.

Figure 6 shows section views of the core of bread obtained from the control flour, as well as the flours having added 1.5% and 3.0% Fibrulina Instant.

As seen inthe picture, control flour shows a relative uniform porosity, with big round pores, even if round in the middle of the section view, and extended towards the superior part.

The flour with 1.5 % added inulin did not differ significantly against the control, the pores being relatively uniform, big and round.

The core of bread obtained from the 3% inulin added flour was characterized by less uniform porosity, big unequal pores, the sides of the section irregular, the product having a "falling" tendency.



CONTROL | 1.5 % Fibruline instant | 3 % Fibruline instant

Fig.6: Views of the bread core

Conclusions

1. The addition of inulin based conditioner does not influence significantly the resistance (P) and the extensibility (L) of dough, up 3% percentage. Over this limit, the resistance and the extensibility of dough begins to decrease significantly.

2. The energy absorbed by dough during the kneading process (W) decreases while the quantity of inulin based conditioner increases. The decreasing of the absorbtion capacity of energy, for inulin added doughs,

shows that the capacit of doughs to retain gases during the fermenting and baking processes is modified enough, for putting significantly in danger the volume of the end product.

3. The inulin addition modified the diastasic activity of the flour type 480 we used for testing, the general tendency being a decrease of the diastasic activity and respectively an increase of the Falling Number parameter. The diastasic activity decreased as the quantity of inulin increased.

4. The inulin addition caused the significant decrease of the hydration capacity of dough, with a proportion depending on the added dose of inulin.

5. The Stability parameter of dough obviously increased in the inulin added flours with respect to the control flours, no matter what their type of extraction.

6. We did not identify significant differences between the aspect of the core of the bread for the bread having 1.5% added inulin, against the bread obtained from the control flour.

7. For the product obtained from the flour type 480, having 3% added inulin, the porosity was less uniform, with big irregular pores, with respect to the product obtained from the control flour.The product also had a "falling" tendency, maybe pursuant to the short fermenting time.

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