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THE EFFECT OF LECITHIN ON ALVEOGRAPH CHARACTERISTICS, BAKING AND SENSORIAL QUALITIES OF WHEAT FLOUR

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Abstract: *Lecithin is a natural surfactant, which could be used like bread improver in order to improve dough rheological behavior, bread quality characteristics and it sensorial properties. The aim of this study was to investigate the effect of lecithin which was added in different doses (0.1-0.5%) into flour with a very good quality for bread making on dough rheological properties and bread quality. Dough rheological properties measured were dough resistance (P), dough extensibility (L), index of swelling (G), baking strength (W) and configuration ratio (P/L) using a Chopin Alveograph. The presence of lecithin influences the alveogram characteristics by increasing dough resistance, baking strength, the configuration ratio P/L and by decreasing dough extensibility and index of swelling. The bread quality characteristics like loaf volume, porosity and elasticity were improved by lecithin addition. Also, bread sensorial characteristics like external appearance, crust aspect, firmness and taste were better evaluated in the sample with lecithin addition. Therefore, by using lecithin on bread making, the effects of baked products are visible in terms of loaf volume, porosity and elasticity increasing, the freshness preserving, as well as the crumb structure improvement. All the results obtained in this study suggested that lecithin can be used in small concentrations as an excellent improver in bread making.*

Keywords: *lecithin, rheological properties, bread characteristics, wheat flour*

1. Introduction

The lipids content in wheat flour is minor and varied between 1.5% and 2.0% most of them being located in the endosperm, germ and aleurone tissue of the wheat kernels [1]. It has been demonstrated that the lipid fractions may be involved in the glutenic complex either through hydrophilic bonds or through hydrophobic interactions. As far as starch-lipid interactions are concerned, the lipid fractions appear as inclusions in the matrix of amylase polyglucans or are chemically tied to carbohydrates [2]. The three main sources of lipids in a typical bread formula are wheat flour, shortening and surfactants [3]. Lecithin, a mixture of phosphatidylcholine, phosphatidylethanolamine, and phosphatidylinositol [4] is a naturally surfactant frequently used in bread making. This type of polar lipid is one of the most widespread phospholipids in nature and is contained in practically all living cells [5]. It can be isolated on an industrial scale from plant sources like soybean, rapeseed, sunflower, e.g. and can be used as improvers in breadmaking, in concentra-

tions up to 6 g/kg of flour [6]. Because of its phospholipids content it can act as emulsifiers, viscosity regulators and dispersing agents [7] in bread making and it improve dough fermentation behaviour, the wheat flour dough rheological properties [8], bread quality characteristics like loaf volume, crumb structure and bread preservation [6] and desirable textural properties such as tenderness, richness, and improved mouth feel [9].

The aim of the present study was to investigate the effect of lecithin on wheat flour with a very good potential for bread-making like raw material. The objectives were to (1) investigate the effect of lecithin on Alveograph rheological characteristics of wheat flour dough chosen like raw material; (2) to determine the bread characteristics (loaf volume, porosity, and elasticity) made with different addition levels of lecithin, and (3) to asses the bread sensorial characteristics made with and without exogenous dose of lecithin addition.

2. Materials and methods

The experiments were carried out on a very good flour quality for bread making. Like flour improver was used crude lecithin from S.C. Enzymes@Derivates Romania (Costişa, Neamţ, România).

The physical-chemical composition of the control flour was analysed according to Romanian standards methods: SR 90:2007, SR EN ISO 3093:2007, SR EN ISO 2171:2002, SR ISO 711:1999, SR 13013-3:1994. The determined values of its physical-chemical properties are the following: acidity 2.2, wet gluten content 27.2 %, gluten deformation index 8 mm, falling number 296 s, ash content 0.64%, humidity 14.3% and protein content 12.42%.

The rheological properties of the control sample and of the flours with different addition levels of lecithin were made on Chopin Alveograph according to SR ISO 5530-4:2005. The parameters obtained from the Alveograph curve are: P, the maximum pressure needed to blow the dough bubble, expresses dough resistance; L, length of the curve, expresses dough extensibility; P/L, configuration ratio of the Alveograph curve; G, index of swelling; W, baking strength (surface area of the curve) [10].

Starting from the flour chosen like row material in experiments, different doses of lecithin were used as follows:

- M - control sample (sample, without exogenous lecithin);
- P1 - sample, with 0.1% addition level of lecithin;
- P2 - sample, with 0.2% addition level of lecithin;
- P3 - sample, with 0.3% addition level of lecithin;
- P4 - sample, with 0.4% addition level of lecithin;
- P5 - sample, with 0.5% addition level of lecithin.

Bread quality characteristics were determined according to SR 91:2007 (ref.).

Sensory characteristics for the bread with lecithin addition, that had the best score for the bread making characteristics, compared with the control sample, was selected. The representative sensorial attributes of bread qualities in conformity with the method described by [11] - the Romanian diagram of evaluation for determining bread quality up to 20 points were: external appearance, crust aspect, firmness, flavor and taste.

Statistical analysis. All analyses were carried out in duplicates and the data obtained were analyzed using Excel software. Values of the parameters are expressed as the mean ± standard deviation to a confidence interval of 95%.

3. Results and discussion

Dough rheological characteristics measurement by Alveograph

Table 1 shows the flour parameters samples with and without lecithin addition recorded by the Alveograph device. The curves performed by dough rheological behaviour through Alveograph method are shown in Fig. 1.

Table 1
Alveograph characteristics of flour samples with and without lecithin addition

Parameters	Symbol	Samples					
		M	**P1**	**P2**	**P3**	**P4**	**P5**
Maximum pressure (mm)	P	76 ± 0.1	84 ± 0.1	94 ± 0.1	113 ± 0.2	117 ± 0.2	121 ± 0.2
Extensibility (mm)	L	85 ± 0.2	81 ± 0.2	76 ± 0.1	66 ± 0.2	64 ± 0.1	64 ± 0.1
Swelling index (mm)	G	20.5 ± 0.1	20.0 ± 0.1	19.4 ± 0.2	18.1 ± 0.1	17.8 ± 0.2	17.8 ± 0.2
Deformation energy (10^{-4} J)	W	211 ± 1	225 ± 2	252 ± 1	264 ± 1	275 ± 1	286 ± 1
Alveograph ratio	P/L	0.89	1.04	1.24	1.71	1.83	1.89

As it can be seen from the Table 1 data the amphiphilic nature of lecithin addition in wheat flour dough conducted to an increase of dough strength in the way of a higher tenacity compared to a lower extensibility which resulted in an increase of the Alveograph ratio P/L from 0.89 to 1.89. Lecithin by it lipophilic and hydrophilic part may form transversal bindings between granular starch and gluten and between gliadin and glutenin forming lipoprotein complexes between starch, gluten and other hydrophobic components. Depending on the binding's complexity it can be formed cross-links which contribute to dough compaction and stabilization and to the formation of the interface resistant films to gas expansion.
The dough strengthening effect of lecithin it may be caused by displacement of the flour lipid binding by lecithin in the dough system. Binding of their lipophilic part to proteins during mixing increases protein aggregation and dough manageability [3]. This fact may predict good dough handling properties and a large fermentation tolerance, especially during final proof [8].

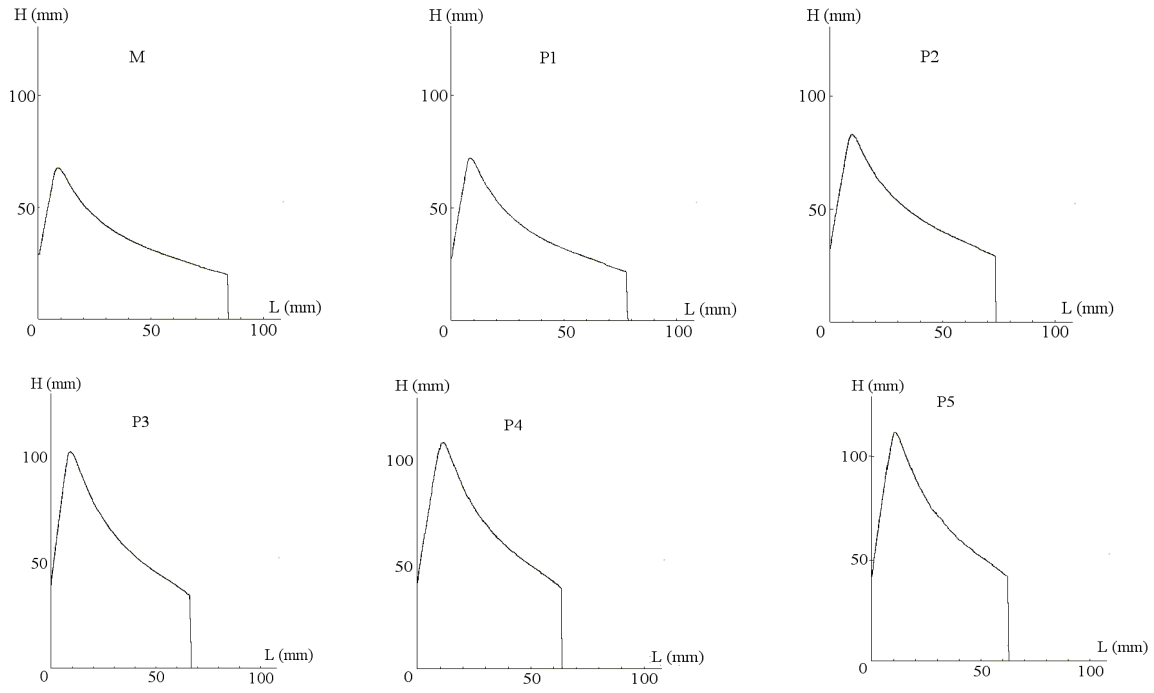

Figure 1. Alveograms of the analyzed samples (M, P1, P2, P3, P4, P5)

Bread making characteristics

Bread loaf volume, porosity and elasticity of the samples with and without lecithin addition are shown in Figure 2. With the increase dose of lecithin addition, loaf volume, porosity and elasticity increase up to 0.3% lecithin addition, for all the samples the values obtained being higher compared to the control one. This positive effect of lecithin on bread characteristics is due especially to its phospholipids content [6]. The phospholipids increase the dough ability of gas-retaining which depends on the foaming properties and stability of the aqueous phase in dough influenced by them [12]. Also phospholipids play an important role in maintaining a stable gas cell structure via its interaction with protein at the gas/liquid interface of liquid lamellae surrounding gas cells in the bread dough [1].

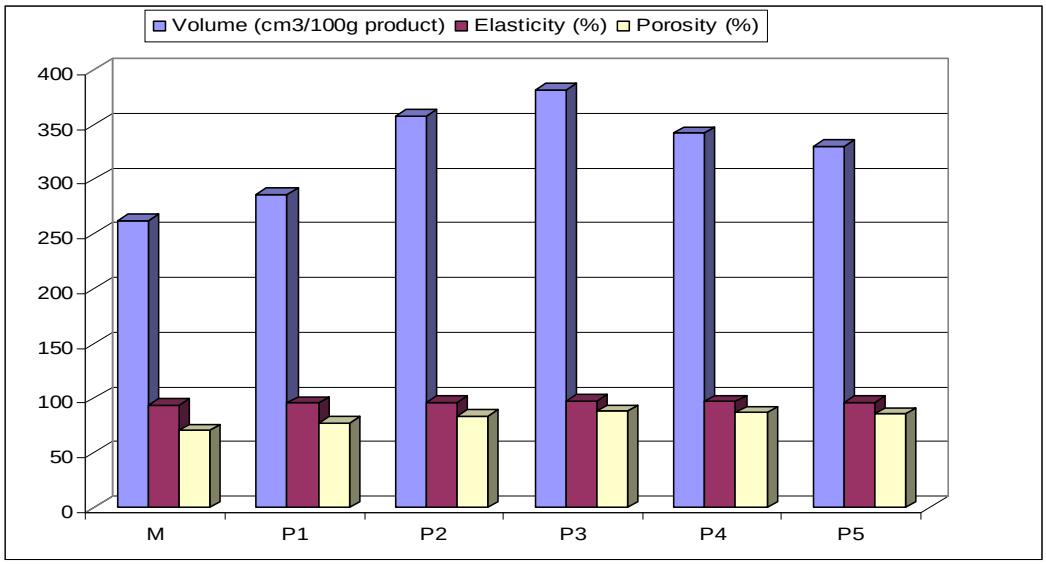

Figure 2. Loaf volume, elasticity and porosity of analyzed samples

Bread sensorial characteristics

The sensorial characteristics of the control sample (M) and of the sample with 0.3% addition level of lecithin (P3) are shown in Figure 3. The bread supplemented with lecithin presented a better evaluation regarding external appearance, crust aspect, firmness and taste. The crumb structure became more uniform, less gumminess with a brighter color. This fact is explainable because water absorption and swelling of the granules is postponed through interaction of lecithin with starch during baking, which creates a softer crumb structure [3], and therefore improve the bread firmness and its external appearance.

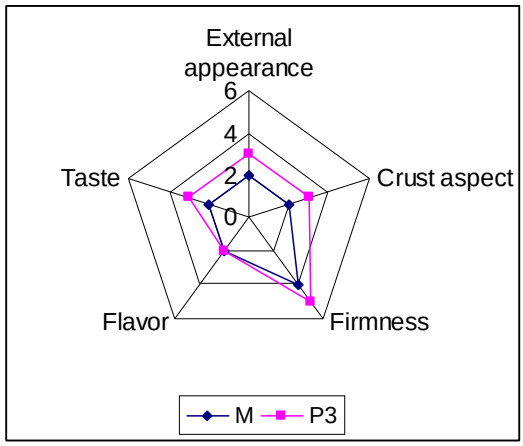

Figure 3. Sensory evaluation of wheat bread samples

4. Conclusions

Flour replacement at different levels (0.1–0.5%) by lecithin significantly changes the measured dough properties by an Alveograph device. Lecithin reduced the dough extensibility and increase dough resistance in the Alveograph, which indicates its strengthened effect on the dough. Regarding the effects that lecithin has on the baking quality characteristics, we concluded that for a 0.3% dose of lecithin addition, we obtained the best quality in terms of bread characteristics.

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