

THE INFLUENCE OF SUCROSE ADDITION ON THE FERMENTATIVE ACTIVITY OF COMPRESSED YEAST AND ON THE QUALITY OF BREAD OBTAINED FROM WEAKER-AVERAGE FLOUR QUALITY IN BREADMAKING

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In the dough, carbon sources are constituted of flour glucides represented by small quantities of glucose, fructose and sucrose. Glucose and fructose can be directly metabolised as they are diffused through the cellular membrane. There is a greater preference for glucose, which is the first to be used in the dough. By decreasing the glucose concentration, the yeast uses the fructose in the dough. The sucrose pre-existent in flour or which is added in dough composition is hydrolysed to glucose and fructose by yeast invertase. The monoglucides formed diffuse in the cytoplasm afterwards, where they are metabolised. Yeast invertase is very active. It hydrolyses the sucrose in the first minutes of mixing; therefore, at the end of this process, the dough only has glucose, fructose and maltose. The introduction of sucrose in the dough is a very common practice in bakeries. By introducing this type of diglucid in the dough, we deal with an increase of fermentable glucid quantity. As a consequence, yeast activity is accelerated. The process occurs until a maximum degree of sucrose is added; afterwards, yeast activity is inhibited. This is why we thought it would be interesting to analyze, in this paper, the way in which an addition of 1.7-3% sucrose added influences the fermentative activity of compressed yeast and bread quality. In order to evaluate the fermentative activity of yeast, we used the device SJA fermentograph and for the evaluation of bread quality, baking tests were carried out. The products have been appreciated from the point of view of the specific volume obtained. Both from the point of view of the fermentative activity and from the point of view of baking samples, the best results were obtained for 2-3% sucrose introduced in the dough obtained from a low-medium quality type of flour used for breadmaking. For the evaluation of the fermentative activity, the SJA device was used.

Key words: SJA fermentograph, sucrose, compressed yeast

The main factors affecting fermentation rates are temperature and osmotic pressure. In dough, osmotic pressure mainly depends on the proportions of sugar and salt used. It can be very high, as much as 35 to 100 atmospheres. This explains the slowdown in the activity of yeast in which metabolism cannot take place normally because water has leaked outside the cell and fewer fermentable sugars can enter. In bread-making, sugar, often added with fat, is responsible for a reduction in dough consistency. It then becomes necessary to decrease dough hydration, which accentuates the concentration phenomenon in the medium. The baker compensates for the drop in fermentative activity by increasing dough and fermentation temperatures, reducing the quantity of salt and increasing the amount of yeast. [1] Doughs containing 4% added sucrose initially ferment at a slightly lower rate; however, since the sugar is not exhausted, fermentation continues without any decrease in activity. A significant inhibition of fermentation is seen in dough with a high level of sugars (10-20% added sugar), which begins fermentation at a much lower rate. During the course of the fermentation, a continual increase in the rate of CO₂ evolution occurs since the osmotic pressure of the dough gradually drops off as sugar is consumed [3].

Many large scale bakeries add sucrose (about 1% to 3%) as an additional source of readily fermentable sugars. They also supply flavor and, when the dough is baked, color. Wheat flour contains only modest amounts of maltose and glucose, and although yeasts do express amylases that can release fermentable sugars from starch, sugar availability may still be growth-limiting. [3, 4] Therefore, we thought it would be interesting to analyze the way in which sucrose addition influences the fermentative activity of compressed yeast with the help of SJA fermentograph as well as the quality of bread obtained through baking tests.

MATERIAL AND METHOD

The determinations were performed by using Romanian wheat flour type 650 with a weaker-average quality, like start material. Flour quality tests, which were accomplished according to Romanian, or international standard methods, indicated the following values: ash content 0.65%, wet gluten content 27.2%, gluten deformation 6mm, gluten index 90, falling number 354sec, farinograph data – water absorption WA 56.9%, development 2.3min, stability 5.8min, weakening 84BU, flour strength 65, alveograph data - tenacity 91 mm H₂O, extensibility 45 mm, index of swelling 14.9, baking strength 156, configuration ratio of the curve 2.02 and extensograph data – energy 35/15/4cm², resistance to extension 138/62/23BU, extensibility 149/142/89mm, max. resistance 184/174/172BU, proving time 45/90/135min.

For the yeast, a compressed *Saccharomyces cerevisiae* type, made by S.C. Rompak S.A. Romania, was used. The used yeasts were analyzed according to standard methods as following: humidity 66.69%, content of dry matter by drying 32.52%, protein content 40%. The raise activity of yeasts in dough made from the control flour was 51.3 min.

The fermentation behaviour of the flours was analyzed at different sugar addition 1.7%, 2%, 2.4%, 3% using the SJA fermentograph. The dough for the fermentograph test is prepared in farinograph (Brabender, Germany). After 5 minutes of mixing the dough sample is placed into the temperate fermentograph chamber at 35°C.

Fermentograph plotter registers the changes in the volume of gases and fermentation time.

Bread recipe comprised flour, water (accord. Flour WA, %), 2% compressed yeast (% flour basis) 1.5% salt (% flour basis) and sugar at different concentration 1.7%, 2%, 2.4% and 3% (% flour basis). Baking tests were done and the loaf volume were analyzed according Romanian standards methods.

RESULTS AND DISCUSSIONS

The fermentative activity of yeast expressed b the emission of carbon dioxide obtained with SJA fermentograph for different quantities of sucrose added, is indicated in *table 1*.

Table 1

CO₂ volume (cm³) relieved during dough fermentation at different doses of sucrose added

Sucrose, %	Fermentation time, min						
	10	20	30	45	60	75	90
0	80	195	335	560	785	1125	1410
1,7	45	160	300	545	810	1120	1410
2	105	215	355	540	845	1205	1500
2,4	85	200	340	580	845	1195	1500
3	65	165	320	510	810	1200	1520

The introduction of a supplementary quantity of sucrose in dough stimulates fermentation and delays maltose metabolization which allows its accumulation in the medium. The sucrose as such is not consumed but the yeast is adapted to consume it. Therefore, yeast releases on the outside, in the free liquid phase of the dough the invertase enzyme which hydrolyzes sucrose obtaining glucose and fructose. Initially, only sugars which are characteristic of flour are fermented - glucose and fructose. After a certain period of time, sucrose fermentation and eventually maltose fermentation begin. This fact is obvious for small concentrations of sucrose (1.7%) added where a stimulation of fermentation is not seen until after 60 minutes of fermentation. Still, it is clear that for higher doses of sucrose added in the presence of this diglucid, the fermentation speed of sugars is increased, probably due to the modifications of the cellular membrane permeability. Thus, for concentrations of 2-2.4% sucrose added, the volume of CO₂ released during fermentation is higher than that of the witness sample. For concentrations of added sucrose which are too high (3%) the sugar addition inhibits the fermentation process by increasing the osmotic pressure in the liquid phase of the dough. Nevertheless, after adapting the yeast in the dough, its fermentative activity starts growing only after 60 minutes of fermentation.

From the point of view of the characteristics of the bread obtained after the baking tests, one can notice an improvement with an optimum of 3% added sucrose. An increase on bread volume is noticed (*figure 1*) in proportion as the added sucrose dose due to the stimulation of fermentation, which delays maltose metabolization and allows its accumulation in the medium.

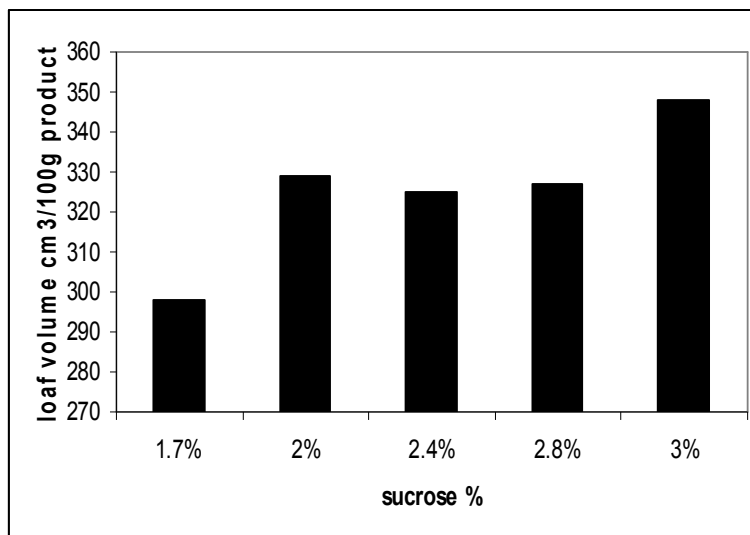


Figure 1 The influence of sucrose addition on bread volume

From the sensorial point of view one can notice a darkening in colour of the bread crust due to the Maillard reaction which forms melanoidine. At the same time, an improvement of the smell and taste as a consequence of the increase of glucid quantity is noticed.

CONCLUSIONS

During 90 hours of fermentation, the highest volume of gases is relieved for an addition of 2-2.4% added sucrose. Nevertheless, from the point of view of the baking samples, the best volume is registered for an addition of 3% added sucrose. In terms of sensorial characteristics, an improvement in proportion as the sucrose added is noticed. This is due to the increase of the glucide content having as a result the formation of a higher quantity of intermediary and final products of the Maillard reactions. As a consequence of the results obtained, we may affirm that it is recommendable use an addition of 2-3% sucrose in bread industry in order to improve the finite products obtained.

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