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Evaluation of fermentative activities of different strains of *Saccharomyces cerevisiae* in bread dough

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Abstract

Fermentative activities of baker′s, brewer's, wine and destiller′s yeast strains in bread dough were studied. Sensoric evaluation of all products was also conducted. Baker′s and destiller′s yeast, applied at concentration 2 % and 4 % respectively, showed high fermentative activities, which amounted to 2314 (ml CO_2/2 h) and 1844 (ml CO_2/2 h) respectively, and gave products which satisfied standards for bakery products. Brewer's yeast, at 4 % concentration, showed slighty lower fermentative activity, 1313 (ml CO_2/2 h) but high enough for bakery production. Wine yeast did not show necessary fermentative activity in bread dough but sensoric evaluation directed its utilization for special bakery products. Significant fermentative activities of destiller′s and brewer′s yeast point to possible use of these secondary products of classical technologies in the bakery. On the basis of sensory evaluation all obtained rolls satisfy the criteria for bakery products. Special aromatic compounds can be obtained only by longer fermentation of dough, and this is characteristic only for bakery products for special purposes.

Keywords: evaluation, yeast, fermentative activitiy, bread dough

Introduction

Among the microorganisms that man consumes every day, yeast is the most well represented. Since the content of yeast in bread and bakery products is 2 to 4% (calculated on flour), this microorganism can certainly be considered as food [1,2].

Saccharomyces cerevisiae strain includes, among others, baker′s, brewer′s, wine and destiller′s yeast. Besides the common characteristics of *Saccharomyces cerevisiae* kinds, these yeasts posess characteristics which are typical for individual strains. The different characteristics of the mentioned yeasts are the result of differences in conditions of multiplying (temperature, aeration, pH), nutrition, chemical composition, growing conditions, tolerancy to ethanol etc [3].

Due to the activity of EMP enzyme complex, the yeast (*Saccharomyces cerevisiae*) cells ferment glucose, fructose, saccharose and maltose, while disaccharides are hydrolized by saccharase and maltase, respectively. The mentioned sugars are the main sugars avaiable to yeast cells in the dough. A part of sugars comes from the flour used for dough making, and the other part is the result of amylolytic degradation of starch in the dough. Ethanol and CO_2 are formed during sugar fermentation. The amount of produced and liberated CO_2 during dough fermentation is characterized by fermentative activity of yeast [4].

The paper presents the results of investigation of the use possibility of different strains of yeast *Saccharomyces cerevisiae* in bakery. The activity of yeast was estimated quantitatively, on the basis of fermentative activity, and qualitatively, on the basis of sensory evaluation of final product.

Methods

The dough was obtained by kneading flour, of average quality, as found at the market (the viscosity, presented by amylogram, is somewhat lower than 750 AJ), tap water, satisfies the quality of drinking-water, table salt and different strains of *Saccharomyces cerevisiae* yeasts. The following yeast strains were used:

- commercial baker´s yeast (from a factory for yeast production); seed culture - sample 1, fresh baker´s yeast - sample 2, dry instant baker´s yeast - sample 3.
- brewer´s yeast (strain V-1, Collection of cultures - Department of Microbiology, Faculty of Technology, Novi Sad, Serbia and Montenegro) - sample 4.
- dry commercial wine yeast (CEG, Uvaferm, Lallemand Inc., Denmark) - sample 5.
- destiller′s yeast (strain A Collection of cultures - Department of Microbiology, Faculty of Technology, Novi Sad, Serbia and Montenegro) - sample 6.

The dough was made with flour, water ≈ 57-60%, salt 1,5% and yeast (dry matter 30%) 2%, 4% and 6% (on flour). All ingredients of dough were tempered at 35°C. The necessary dough amount was kneaded in the mixer for 5 min at 85 rpm. After kneading the dough was divided in pieces of certain mass (445 g for the determination of fermentative activity and 110 g for test baking). The test baking was performed by differential method, which was chosen so as to obtain rolls of the best quality: dough temperature 30°C, fermentation time in mass (30 + 15 min, 32°C); final fermentation (time determined by experience method: 55±5min, 30°C); baking time (12 min, 225 ± 5°C).

The yeasts used were analyzed: content of dry matter by drying, proteins [5], total carbohydrates and trehalose [6]. The fermentative activity of yeasts in dough was determined as the volume of formed and liberated CO_2 during 1^h and 2^{hrs} in triplicate [7]. The measured values were used to calculate the specific yeast activity which represents the volume of liberated ml CO_2 in 2^{hrs}/1 g of yeast dry matter.

The bakery products were evaluated sensorily applying the descriptive method.

Results

Yeasts produced on different media by different processes were used in this work. In order to recognize objectively the obtained results, the analysis of yeasts used for the dough are presented in Table 1.

Table 1. Content of dry matter, proteins, total carbohydrates and trehalose in *Saccharomyces cerevisiae* strains

Yeast strain	Dry matter (%)	Total proteins (% dry matter)	Total carbohydrates (% dry matter)	Trehalose (% dry matter)
sample 1	17,95	51,53	30,00	4,4
sample 2	29,30	51,19	25,50	5,1
sample 3	95,32	42,87	39,20	18,7
sample 4	22,50	38,88	12,40	7,1
sample 5	84,98	40,82	22,60	15,8
sample 6	23,28	61,75	4,61	1,7

Sample 1-commercial baker's yeast
Sample 2-fresh baker's yeast
Sample 3-dry instant baker's yeast
Sample 4-brewer's yeast
Sample 5-dry commercial wine yeast
Sample 6-destiller's yeast

The analysis of fermentative activity of yeasts was done in three parallel repetitions. The measured e.g. calculated volumes of liberated CO_2 during 1^h and 2^{hrs} of dough fermentation are presented in Table 2.

Table 2. Measured volumes of liberated CO_2 during 1^h and 2^{hrs} of fermentation of dough made with *Saccharomyces cerevisiae* strains

Yeast	Content in dough (%)	Fermentative activity		
		in 1^h (ml CO_2)	in 2^{hrs} (ml CO_2)	specific (ml CO_2/g dry matter in 2^h)
Sample 1	2	915	2270	1351,6
	4	1506	3279	976,0
	6	2115	4460	855,0
Sample 2	2	997	2313	1410,8
	4	1656	3271	997,2
	6	2385	4770	969,4
Sample 3	2	503	1280	727,2
	4	817	1950	554,0
	6	1012	2256	427,3
Sample 4	2	415	865	527,4
	4	725	1315	401,5
	6	975	1795	364,1
Sample 5	2	180	430	255,9
	4	450	925	275,3
	6	475	1050	208,3
Sample 6	2	600	1430	851,2
	4	825	1840	548,9
	6	1173	2552	507,3

Sample 1-commercial baker's yeast
Sample 2-fresh baker's yeast
Sample 3-dry instant baker's yeast
Sample 4-brewer's yeast
Sample 5-dry commercial wine yeast
Sample 6-destiller's yeast

During fermentation of dough, aroma products are formed. The results of sensory evaluation of finished products are presented in Table 3.

Table 3. Evaluation of bakery products obtained using in *Saccharomyces cerevisiae* strains

Evaluated characteristic	Yeast				
	Sample 2 2%	Sample 3 4%	Sample 4 4%	Sample 5 6%	Sample 6 4%
Appearance					
crust colour	reddish-brown	reddish-brown	reddish-brown	reddish-brown	reddish-brown
crust softness	hard	hard	hard	hard	hard
crust thickness	thin	thin	thin	thin	thin
Appearance of crumb					
elasticity	very good	satisfying	satisfying	not satisfying	good
fineness of pores structure	fine	coarse	slightly coarse	coarse	almost fine
pores univormity	rather univorm	rather univorm	rather univorm	ununiform	rather univorm
odour of crust and crumb	characteristic	specific aromatic on fermentation	characteristic	overly sweet	characteristic
taste of crust and crumb	characteristic	characteristic	characteristic	neutral overly sweet	characteristic
shape	regular	regular	regular	regular	regular
volume	400 ml	315 ml	385 ml	332 ml	467,5 ml
penetrometric number	62	44	65	45	94
number according to Dallman	5-6	6-7	6	5	6

Discussion

The results presented in Table 1 point to significant differences in total proteins and total carbohydrates content in used yeast samples. The content of these components is low in seed culture (sample 1) and in fresh baker′s yeast (sample 2) [7]. The proteins content of dry yeast (sample 3) was very low, as the result of nitrogen content decrease in the medium in the final phase of multiplying The content of trehalose is increased in dry baker′s and wine yeast (sample 3 and sample 5). During the drying process and starving of cells trehalose is separating as reserve food and antistress factor in yeast cells [8,9,10]. The content of total carbohydrates of brewer′s yest is significantly lower compared to baker′s yeast. The high protein content in destiller′s yeast (sample 6) points to good assimilation of nitrogen from the medium where yeast was multiplying.

The results presented in Table 2 show that the fermentative activity of seed culture (sample 1), fresh baker′s yeast (sample 2) and destiller′s yeast (sample 6) was very high with the addition of only 2% to dough, in two hours of measurement. The high protein content of these samples points to high enzymatic activity of yeast cells [4]. The fermentative activity of dry baker′s yeast (sample 3) is moderate. On the basis of protein and total carbohydrates content of brewer′s yeast (sample 4), no higher fermentative activity could be expected. Dry wine yeast (sample 5) has expressed low fermentative activity. The increase of yeast amount in the dough, in our work, hasn′t result in increase of specific yeast activity. This can be explained by relatively low amylolytic flour activity, so the amount of maltose was not enough for higher number of yeast cells.

The results of sensory evaluation of bakery products (Table 3) show that the appearance of rolls was acceptable, with hard, thin and reddish-brown crust. The crumb elasticity and uniformity of pores were not satisfactory only in rolls prepared with sample 5. The smell of crumb and crust of the same sample were not characteristic for bakery products. The largest volume was recorded in rolls prepared with samples 2 and 6, and the least with sample 6, and this is in accordance with the fermentative yeast activity. The compressibility of crumb was the highest in sample 6, while the size of pores was rather uniform in all samples, however, sample 5 is differing with largest pores.

Conclusion

The results obtained have shown that all investigated yeasts can be used for the production of bakery products. However, wine yeast can be used only for production of bakery products for special purposes. The fermentative activity of brewer′s yeast can be probably increased by optimizing the medium composition. Significant fermentative activities of destiller′s and brewer′s yeast point to possible use of these secondary products of classical technologies in the bakery. On the basis of sensory evaluation all obtained rolls satisfy the criteria for bakery products. Special aromatic compounds can be obtained only by longer fermentation of dough, and this is characteristic only for bakery products for special purposes.

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