THE EFFECT OF YEAST GROWTH STAGES ON THE ABSORPTION OF POLYPHENOLS

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INTRODUCTION

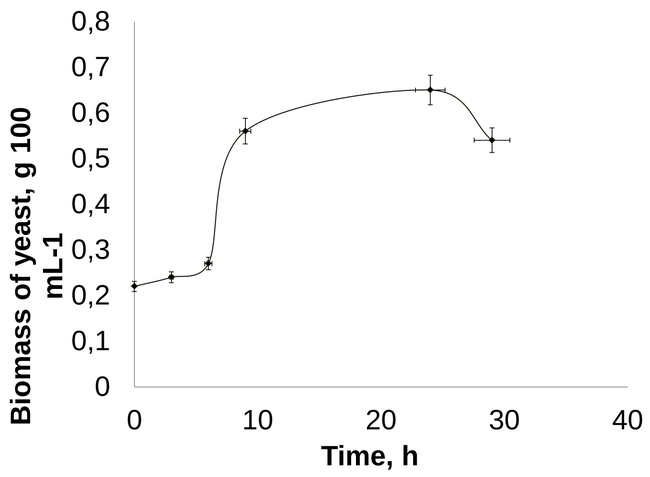
Colloidal stability of beer is one of the most critical challenges facing the brewing industry .In brewing, to increase colloidal stability, the **stabilization agents** are used .The most widely used products today are silica gel for protein stabilization and Polyvinylpolypyrrolidine (PVPP) for polyphenols stabilization [4]. However, the removal efficiency of polyphenols depends on the yeast, which adsorbs these compounds on its surface [3]. The adsorption of **polyphenols** on the yeast surface is associated with the zeta potential of the cell wall, which correlates with the content of **mannan polysaccharides** in them[4]. In context, the purpose of this study was to investigate the role of yeast strains in the adsorption of polyphenols on its cell wall during wort fermentation and establish the correlation this characteristic with the content of mannan in yeast cells at the various stages of growth yeast.

THE MAIN MATERIALS AND METHODS

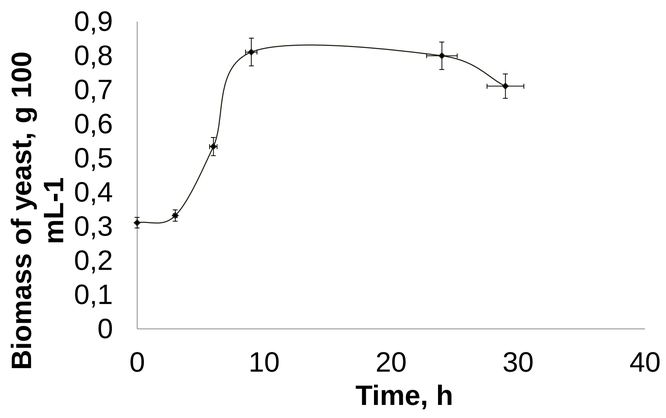
Research objects were dry yeast ***S. cerevisiae Californian Lager* (M54)** (Mangrove Jacks, New Zealand) and ***S. cerevisiae Belgian Wit* (M21)** (Mangrove Jacks, New Zealand).
Spraymalt light barley wort extract (Muntons, England) was used to prepare the medium.
The fermentation process was carried out in incubator (TC-1/80 CPU, Russia) on the principle of a batch culture without forced aeration at temperature 28°C for 29 hours.
Extraction and estimation of crude mannan: We extracted mannan from 2 g of dry yeast extraction with 1% NaOH (50 mL) at 100°C for 2 hours, cooling and neutralizing to pH 7 with dilute HCl solution .Deprotienization carried out using the TCA (trichloroacetic acid) method .The quantitative estimation of mannan was determined by the phenol-sulfuric acid method using glucose as standard [1].
Determination of polyphenols: The polyphenols were determined according to the EBC method 9.11 using a 'UV 1240' spectrophotometer from 'Shimadzu' at the wavelength of 600 nm.
The accumulation of yeast biomass: We determined it by the weight method after drying the suspension of washed yeast to constant weight at 105°C for 24 h in cabinet dryer ES-4610 (Reaktivsnab, Shymkent, Kazakhstan).

RESULTS

A – The growth and multiplication of yeast



The growth curve of the *Saccharomyces cerevisiae Californian Lager* M54 in a batch culture



The growth curve of the *Saccharomyces cerevisiae Belgian Wit* M21 in a batch culture

B –Mannan and polyphenols determination

The variation of the specific growth rate of yeast in the culture fluid and The content of mannan in yeast during the time of cultivation

Period of the cultivation (h)	*S. cerevisiae Californian Lager* (M54)		*S. cerevisiae Belgian Wit* (M21)	
	Mannan (%*)	Specific growth rate (h^{-1})	Mannan (%*)	Specific growth rate (h^{-1})
0	6.96 ± 0.007	-	6.88 ± 0.005	-
3	7.63 ± 0.006	0.029	9.35 ± 0.008	0.081
6	8.83 ± 0.007	0.034	11.21 ± 0.002	0.090
9	**10.97 ± 0.008**	0.10	**13.69 ± 0.003**	0.106
24	19.45 ± 0.007	0.045	13.16 ± 0.002	0.040
29	9.77 ± 0.005	-0.04	12.75 ± 0.004	-0.028

*** mg mannan/mg dry cell weight**

The specific rate of change in the polyphenol content in the culture fluid during the time of cultivation.

Time intervals (h)	The specific rate of change in the polyphenol content (h^{-1})	
	S. cerevisiae Californian Lager (M54)	*S. cerevisiae Belgian Wit* (M21)
0-3	- 0.155	-0.046
3-6	- 0.102	-0.073
6-9	-0.021	-0.045
9-24	**0.016**	**0.023**
24-29	0.026	0.030

The polyphenol content in the culture fluid during the time of cultivation

Period of the cultivation (h)	*Content of the polyphenols (mg L^{-3})*	
	S. cerevisiae Californian Lager (M54)	*S. cerevisiae Belgian Wit* (M21)
0	171.60 ± 2.333	168.91 ± 1.003
3	109.30 ± 1.320	156.66 ± 0.325
6	79.83 ± 3.083	117.33 ± 3.232
9	**72.86 ± 1.653**	**102.66 ± 2.583**
24	94.93 ± 4.763	109.73 ± 1.063
29	110.06 ± 1.013	119.03 ± 2.403

DISCUSSION AND CONCLUSION

We have found that the concentration of mannan varies depending on the yeast growth stages and the yeast strains ,and this corresponds to the results obtained by Moreno and colleagues [2].
The highest mannan content in yeast was at the end of the exponential phase of growth, where its content was 10.97 % in the yeast *S. cerevisiae Californian Lager* (M54) and 13.69 % in the yeast *S.cerevisae Belgian Wit* (M21).
The adsorption of polyphenols depends on **the mannan content in the yeast**, which was the highest when the yeast was on the exponential phase (log phase).
For this reasons, we consider that, **in order to increase the colloidal stability of beer**, and reduce the consumption of stabilizers in particular PVPP; it is necessary to **remove the yeast from the fermentation tanks at the end of the exponential phase of growth**, that is, before the desorption of polyphenols from the surface of the yeast.

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