LABORATORY STUDIES CONCERNING COLLOIDAL STABILITY'S BEER USING ADSORPTION METHODS

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ABSTRACT: *So as to ascertain a higher stability until 6÷12 months, it is necessary that breweries to perform the colloidal stability of the beer. The work shows the own researches upon colloidal stability's improvement by the two stabilizing substances' addition bentonite and silica gel into the beer as finished product. Also, it was observed the influence of those substances upon the beer's sensorial features.*

KEY WORDS: *beer's stability, adsorption, stabilizing agents*

1. INTRODUCTION

Both the continual increment of the beer production and the trend a lot of consumers to keep the beer at different temperature than the common one ($8\div10^0$C) impose the some beer's obtainment having higher stability.

As it knows, the beer stability is limited. The keeping period of the limpidity is shorter than 6 weeks, and depends of the next factors: absolute quantity and the structure of the colloidal substances having proteic, polyphenolic and polysaccharide origins existed into the beer, what are responsibly in the muddiness' setting up; substances quantity from beer, which have catalytic actions upon the muddiness' settings (oxygen and heavy metals), or slowly actions (reductones); pasteurization, transport and storage conditions (influences of temperature, agitation and light).

The muddiness' appearance has often accompanied taste changes of beer, too; thus, owing to the crossing of some proteins into insoluble aspect has depreciated upon beer fulfillment and could appear "proteins" uncomfortable taste, while owing to the polyphenols' polymerization the beer could get a rough taste.

The causes getting the beer fulfillment's loss can have colloidal or biological origins. Beer stability depends on the concordance of these two aspects, so that a beer is initially stable of the colloidal standpoint, and it looses this feature later in the same time with the appearance of the biological origin muddiness and reversing.

In a large measure, the taste stability depends the colloidal and biological one, and the factors leading to their improving have the positive influence upon the taste stability, too. From among factors having influences upon the beer's colloidal stability it is mentioning:

- Barley's quality; among barley's component parts being important for the beer stability especially these are the proteic and polyphenolic substances those are the long afterwards forerunners for the muddiness from the beer;
- Malt solubilization in the germination; the richest malts and the intensely proteolytic solubilized one to germination supply worts with higher content of nitrogen substance during the germination, what leads to the color intensification, the foam, taste and colloidal stability's depreciation;
- Dry temperature of the malt; higher dry temperatures for the malt produce on the one hand an intensive coagulation of the macromolecular proteins, and an intensively inactivating of the proteolytic enzymes on the other hand;
- Malt's crushing proceeding;
- Mashing-saccharifying proceeding applying in the used mashing temperatures' conditions;
- Hop's quality and decoction conditions of the beer wort; the short standing decoction of the wort only by 30 minutes depreciates beers' colloidal stability, their muddiness trends being about two times higher than the 90 minutes long fermentation;
- Cooling and clearing proceeding of the used beer wort;
- Fermentation and maturation conditions; for instance, fermentation on higher temperatures have a faster decreasing of the pH, and the proteic fractions' separation from the beer are more intensively. Thus, the colloidal stability is improved, but the foam and fulfillment of the beer is decreasing;
- Filtration and pasteurization of the beer; the beer's pasteurization having main target the biological stability of it produces a colloidal stability's depreciation or even some "pasteurizing" muddiness.

So as to ascertain a higher colloidal stability until 6÷12 months it is necessary the colloidal stability of the beer. The colloidal stabilizing methods of the beer contents of two groups:

- Adsorption methods (bentonites, silica gels, polyamides and polyvinylpolypyrrolidones, active carbon), which adsorb proteic, polyphenolic fractions and other substances from beer;
- Chemical methods, which can action on precipitating reaction of some muddiness forerunner's fractions (gelatin, tannin, formaldehyde), and the depreciation enzyme reactions of the macromolecular fractions that leads to muddiness' appearance (proteolytic enzymes, glucanases), or these can action on diminution of the beer's pH (SO_2, ascorbic acid, natural reductones obtained from malt).

All these used stabilizing substances are insolubly into the beer, and it can eliminate from beer by filtrating after their stabilizing actions, or even used as filtrating auxiliary material.

Owing to these advantages, those have already found a wide spreading usage even to the countries standards not permitting strain substances into beer production. This paper observed colloidal stability's improvement of the beer by addition of bentonites and silica gels into finished product.

2. MATERIALS AND METHODS

For the experiments was used blonde beer samples obtained in the laboratory conditions, and were achieved in the filtration section from brewery of Bacau, using beer samples filtrated before the bottling production phase. As stabilizing agents were used:

- Bentonites – aluminum silicates having adsorption action, especially for the proteic fractions with molecular weight more than 4600 or even for some fractions having lower molecular weight;
- Silica gels – synthetic compound on the basis of silicic acid having adsorption action upon proteic fractions with molecular weight more than 12000 value.

According to Romanian standard method, the bottled beer is keeping into thermostat on 20^0C, no agitation, and the days number starts counted from the bottled day of the beer till to the day when the limpidity fails or some sediment's appearance. That day's number means the beer stability.

In the investigation of the beer's colloidal stability it was used the cooling "compelled' method and the warming one ($0/40/0^0$C), too.

That method permits a faster determination for the colloidal stability of the beer foreign the muddiness appearance by the alternative maintaining of the beer at 0^0C and 40^0C on 24 hours long, thus establishing the days' number until a muddiness' appearance. An estimate for the beer's stability depending on day's number is done as following:

- Less 1 day – low stability;
- 1÷2 days – satisfactory stability;
- 2÷5 days – very-good stability.

The stability on $0/40/0^0$C can be transformed into foreseeable stability of the beer (for instance, the determined one by the standard method) by means of the formula:

$$\textit{Beer's stability (days)} = \textit{stability on } 0/40/0^0\textit{C (days)} \times 10 \qquad (1)$$

As analysis methods, it were used:

- Color of beer – observing of view comparison of the analyzed sample's color with the iodine solution's color having a known concentration;
- pH of beer – using the electrometric method, by means of a laboratory pH-meter;
- Foam stability – using the times measuring for the persistent foam, starting from the moment when the beer touches the tasting glass till to its total vanishes;

- Stability of beer – using the cooling and warming "compelled" method.

3. RESULTS AND DISCUSSIONS

The beer samples treated with stabilizing agents have been alternatively kept on 0^0C and 40^0C temperatures until the moment of the beer's stability was lost. After that, it was investigated the performed treatment's efficiency making the organoleptic and physical-*chemical* features of the treated beer samples in comparison with a control sample, too. Using the bentonite (BENTOPUR) as colloidal stabilizer, it has obtained the following experimental results, showing into the table no 1.

Table 1. *- The bentonite's influence upon the beer's colloidal stability*

Sample number	***Bentonite quantity [g/hl]***	***Physical-chemical indicators***			
		Color [ml/I_2 0.1n]	***Foam's stability [sec.]***	***pH***	***Beer's stability [days]***
1	-	1.5	130	4.35	1
2	30	1.4	128	4.30	4
3	50	1.4	129	4.40	5
4	70	1.3	128	4.29	7
5	90	1.1	122	4.25	13
6	110	1.0	123	4.38	20
7	130	0.98	120	4.45	28
8	170	0.95	117	4.50	32
9	200	0.85	108	4.30	40
10	220	0.83	97	4.35	41

Using the silica gel (SILICALIT) as colloidal stabilizer, it has obtained the experimental results into the table no 2.

It is observed that to the same added stabilizing substance's dose the beer's color is lighter for the case of the bentonite addition. This stabilizing substance influences lowlier the sensorial features of the beer, than the silica gel addition.

Table 2. - *The silicagel's influence upon the beer's colloidal stability*

Sample number	***Silicagel quantity [g/hl]***	***Physical-chemical indicators***			
		Colour [ml/I_2 0.1n]	***Foam's stability [sec.]***	***pH***	***Beer's stability [days]***
1	-	1.5	130	4.35	1
2	30	1.5	128	4.32	4
3	50	1.5	129	4.40	6
4	70	1.4	127	4.29	7
5	90	1.3	127	4.25	12
6	110	1.3	125	4.37	21
7	130	1.2	126	4.40	27
8	170	1.0	123	4.53	33
9	200	0.95	122	4.27	37
10	220	0.95	124	3.90	15

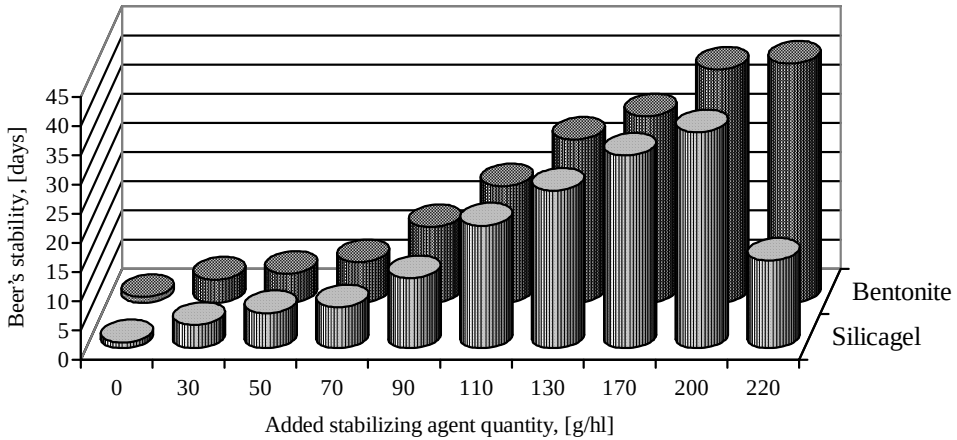

Figure 3. - *The influence of the stabilizing substances upon the beer's stability*

For the analyzed beer samples, the foam stability has presented dose values, excepting of the beer samples having the bentonite dose increased to 200÷220 g/hl beer, which registered the lowest values of the foam's stability (table 2). The calculating of the beer's foreseeable stability performed the estimate of the beer's stability depending on the day's number.

The graph (figure 1) shows that bentonite usage as stabilizing agent leads to a very good stability for the samples 8, 9 and 10. Using silica gel, it is obtained a very good stability for the samples 8 and 9, the increment of the silica gel dose to 220 g/hl leaded to the depreciation of the beer's stability.

4. CONCLUSIONS

The increasing of the silica gel doses from 30 to 220 g/hl has improved the beer's colloidal stability, but the sensorial features (color, foam stability) depreciated. When the bentonite doses increase from 30 to 220 g/hl, the beer's color becomes lighter and the sensorial features are almost the same.

It is recommended the combined usage of the both stabilizers. Owing to the bentonite hydration, it is losing big quantities of beer into formatted sediment. The treatment of the beer with bentonite, it is recommended to use to the storing, before filtrating with 3÷7 days. The silica gel doesn't hydrate, thus, the beer losses are lower. This means the benefit of a smaller contact period with the beer, being able to be dosed into the beer before the filtration.

5. REFERENCES

[1]. Banu, C, *et al*. (2001), *Tratat de ştiinţa şi tehnologia malţului şi a berii,* Vol. II, Editura AGIR, Bucureşti
[2]. Brrigs, D.E. (1995), *Malting and Brewing Science*, Chapman et Hall, London
[3]. Kunze, W. (1996), *Technology brewing and malting*, VLB, Berlin
[4]. Narziss, L. (1985), *Technologie der Würzebertung*, Enke-Stutgart