RESEARCH ARTICLE **(Open Access)**

Advantages of beer produced of basic extract of high gravity compared to beer produced of normal gravity

MYBESHIR PAJAZITI[1*] & RENATA KONGOLI[2]

[1]The Department of Biotechnology and Food, Agricultural University of Tirana, Tirana 1030, Albania,

[2]The Department of Biotechnology and Food, Agricultural University of Tirana, Tirana 1030, Albania,

*Corresponding author e-mail: *mpajaziti57@hotmail.com*

Abstract

This study was done to attain a higher quality beer by optimizing the production process at a lower cost at the J.S.C. "Birra Peja" brewery, Peja, Kosovo. The aim of this study was to increase the extract concentration without reducing the beer quality, which in turn would make the brewery lose its market competitive edge. We studied and monitored the beer quality and the organoleptic characteristics in order to compare the beers produced of four different concentration basic extracts: E = 10.5 ^{o}P; E = 13 ^{o}P; E = 15 ^{o}P; and, E = 16 ^{o}P. The study was reviewed by the technical laboratories at "Birra Peja" and "Union Brewery", Ljubljana, Slovenia. Quality tasting was made from two tasting groups, each from the above-mentioned breweries. Chemical and microbiological tests were based on methods under the "EBC (European Beer Convention)" and the "MEBAK (Mitteleuropäische Brautechnische Analysenkommision e.V.)" guidelines. Based on the conducted analyses, we have come to the conclusion that beer produced of 16 ^{o}P basic extract is of higher quality and this is the beer that will be produced at "Birra Peja" brewery.

Keywords: basic extract, high gravity beer, ECB, MEBAK.

1. Introduction

The most promising method to improve the yeast fermentation process in the high gravity beer is to increase the rate of pitching the fermenting yeast. Fermentations with four (4) different rates of yeast pitching (1.5 × 107, 2.0 × 107, 3.0 × 107 and 4.0 × 107 stable cells / sweet solution ml) are done to investigate the impact of the changing quantity of yeast added in order to achieve the goal set for successful fermentation and successful production of beer with 10.5 ^{o}P, 13.0 ^{o}P, 15.0 ^{o}P, and 16.0 ^{o}P. The obtained results show that the highest rate of pitching result in a higher number of maximum yeast cells in the future as well as the highest sugar quantity, ethanol production rates, the level of diacetyl in green beer, and the quantities of high alcohols and esters. Results also show that the method itself is even more effective than a method of adding a sweet solution food supplement, or a combination of these two methods in relation to the amount of sugar, ethanol production rates, ethanol, concentrations of diacetyl, high alcohols and esters in green beer [3].

High gravity beers may be described as a procedure that involves wort of higher concentration than the normal. For many years we have worked with wort of 10.5 °P, which was fermented and the beer produced was of 4.2% (v / v) ethanol alcohol. In high gravity beer, the wort gravity can reach up to 16 °P, resulting in high concentration of ethanol in green beer. After fermentation, the product has been diluted, usually with water of released oxygen, in order to have a beer with regular ethanol content (4.2%) or the desired alcohol content. The dilution process has been often performed at the later stages of processing, usually after the filtration process or right before packaging. This process is conducted with de-aired water that consists of 0.002% oxygen.

The production of high gravity beer has been highly improved in recent year because of a large number of its benefits:

- **Increased production capacity** as a result of a higher utility rate of the existing brewing/wort production facilities
- **Reduced operational costs** due to lowered energy use, shortened production period, less cleaning needed
- **Improved organoleptic properties** due to increased physical stability, improved taste and beer aroma
- **Lower yeast rising** as a result of higher alcohol concentration per unit of fermented extract

*Corresponding author: Mybeshir Pajaziti, E-mail: mpajaziti57@hotmail.com
(Accepted for publication 24 March 2014)
ISSN: 2218-2020, © Agricultural University of Tirana

- **Higher yeast rates** at the pre-fermentation period

For example, using 15 ^{o}P wort, leads to lowering the power consumption by as much as 14% and increasing the productivity of the workforce (25-30%) [4].

All of these priorities have been calculated on the basis of preliminary annual results. However, this technology still has some problems: decreased stability of beer foam, changed taste which may be perceived negatively by the clients, and a negative effect on the performance of yeast due to high osmotic pressure and ethanol concentration, leading to a lower rate and longer fermentation [2].

In addition, high levels of yeast pitching has been considered recently as a possible method of attaining high gravity beer due to its typical advantages, such as shortening the fermentation time, increasing the rate of fermentation, and increasing the dilution rate. The beer traditionally produced at the "Birra Peja" brewery has a pitching rate of wort of 5-20 million cells/ml. However, in the high gravity beer, to increase fermentation, this rate should be increased about two fold higher than normal. It is clear that although these results indicate that these high rates of wort pitching are favourable for high gravity beer, they do not significantly impact the normal (10.5 ^{o}P) extract beer. Nonetheless, the aim of this study was not to highlight the effects of the rate of pitching of wort, but of the production of the 16 ^{o}P high gravity beer.

2. Materials and methods

Wort of 16 ^{o}P is prepared by brewery performed done with 100% malt in the decoctions processing. For this work, we used water from the "Drini i Bardhë" spring, Peja, Kosovo with 9.5 degrees of General Hardness (9.5 °dGH); hops or Humulus lupulus originating from Slovenia, which was made of 70% Aurora (bitter) and 30% Golding (aromatic). In the first case of beer produced with 10.5 ^{o}P, we had 6.3 gr. α-acids/hl and, in the other three (3) cases, even though the grammage of α-acids/hl was increased in proportion to the increased extract the proportion of hops remained the same. Yeast which was used for producing these beers is Saccharomyces Carlsbergensis. Procedures and parameters during the phases of the wort processing were kept constant for obtaining the wort in all four (4) cases. The content of the initial dissolved oxygen was 10 ppm. The main fermentation is conducted and completed at 14 °C, where 80-85% of the extract was consumed. The results of analysis of beer and the histograms of beer analysis are presented in the table 1 and figure 2. The data show that increasing the concentration of initial extract is associated to the increasing the values of real rate of fermentation, apparent rate of fermentation and alcohol content of beers.

During fermentation the work of yeast, temperature, the amount of carbon dioxide, the amount of ethanol, and gravity were continuously monitored.

This study was done in the period November 2012 - February 2013 at the J.S.C. "Birra Peja" brewery, Peja, Kosovo.

3. Results & discussion

Changes in the organoleptic properties of the high gravity beer (16.0 °P) and in the cost of the final product are observed from the maturation, beer filtration and storage. The cost for filtering the beer has fallen in proportion to the previous index. One should mention the energy savings of about 15% during the preparation of wort; the energy saving during the main fermentation and maturation of about 13%; 43% increase of the utilization of the brewery operational capacity as compared to the wort produced from the 10.5 °P.

Additionally, due to changes in the production recipes we have reduced by 90% the substances that are used for stabilization (proteins and polyphenols).

The data of Table 2 (Analysis of the secondary products of fermentation) and Figure 1 (The histogram of the secondary products of fermentation) show the changes in the amount of secondary fermentation products such as increased amount of esters and reduced amount of higher alcohols, which then leads to changes in taste of beer.

So the beer produced by this method has the consistency of taste over time because it does not come to the oxidation of polyphenols. Table 3 (Results of beer tasting) shows the separate scoring, aggregated for the purpose of this paper, of the two (2) expert tasting groups, one from "Birra Peja" brewery and from "Union Brewery", Ljubljana. Beer produced of the 16 °P initial extract was graded higher.

Table 1. Analysis of beer

Date of Work Samples of Beer	*Basic extract %*	*Real extract %*	*Apparent extract %*	*Real rate of fermentation %*	*Appar. rate of ferment. %*	*Alcohol %v/v*	*Density 20/20*	*CO_2 g/l*	*pH*	*Color EBC*	*Bitter EBC*	*O_2 total mg/l*	*Polyphenols mg/l*
25.05.2012 Ex=10.5°P	10.30	3.33	1.67	68.8	83.74	4.53	1.0065	5.2	4.53	7.60	21	0.15	176
22.07.2013 Ex=13.0°P	10.50	3.68	2.05	66.2	80.44	4.46	1.0080	5.1	4.71	8.00	21	0.14	148
08.01.2013 Ex=15.0°P	10.56	3.26	1.52	70.33	85.62	4.76	1.0059	5.3	4.61	7.80	23	0.38	113
11.01.2013 Ex=16.0°P	10.62	3.23	1.47	70.78	86.16	4.82	1.0053	5.1	4.92	7.80	21	0.26	163
min/max	10-11				78-84	3.7-4.7		4.7-5.7	4.2-4.6	7.5-10	20-26	0-0.5	145-175

Table 2. Analysis of the secondary products of fermentation

Data of work Samples of Beer	*Diacetyl (mg/l) 0.1*	*Pentanedione (mg/l) 0.6*	*DMS (mg/l) 0.03-0.12*	*Acetaldehyde (mg/l) 2-20*	*Ethyl Acetate (mg/l) 5-30*	*Iso-Amyl Acetat (mg/l) 1-5*	*Propanol (mg/l) 5-30*	*Iso-Butanol (mg/l) 5-20*	*Iso-Amyl Alcohol (mg/) 50-60*
25.05.12 (Ex = 10.50°P)	0.025	0.10	0.056	14	12	0,97	12	18	60
22.07.12 (Ex = 13.00°P)	0.031	0.21	0.055	9	14	1.21	11	15	58
08.01.13 (Ex = 15.00°P)	0.012	0.14	0.037	5	17	1.00	11	12	43
11.01.13 (Ex = 16.00°P)	0.012	0.10	0.025	5	17	1.15	12	14	35

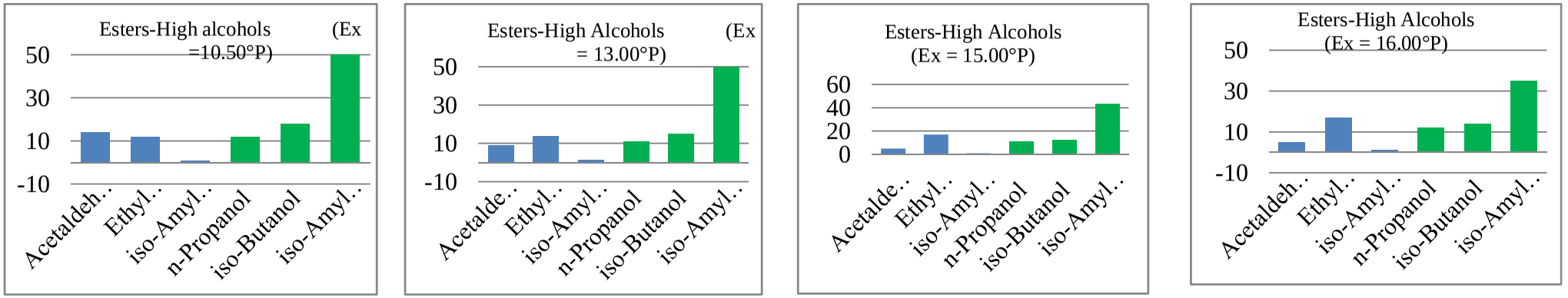

Figure 1. The histogram of the secondary products of fermentation.

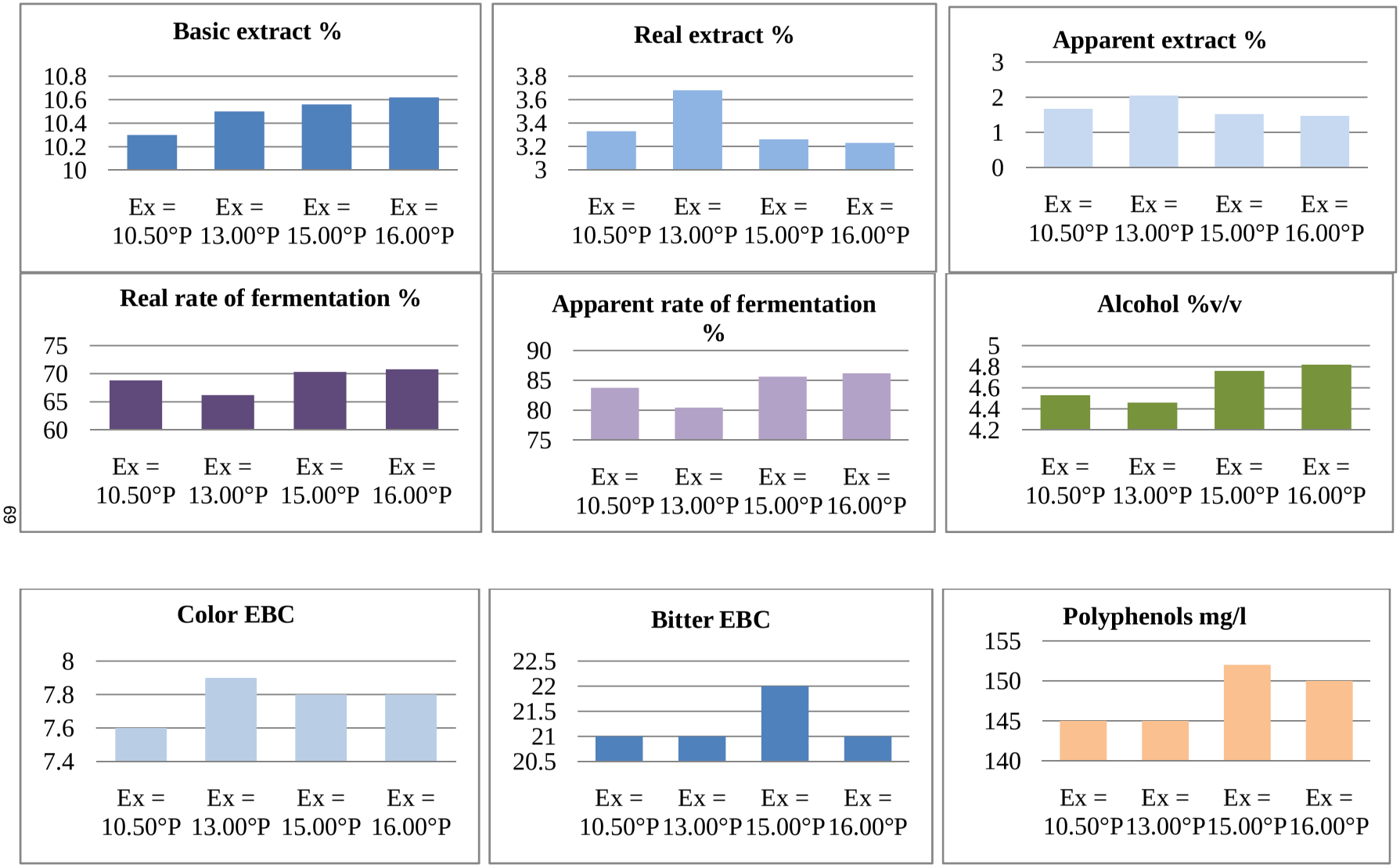

Figure 2. The histogram of beer analysis

Table 3. Results of beer tasting

Beer tasting					*Date: 15.02.2013*
Organoleptic characteristics	**Sample**				Maximum points
	10.50 °P	13.00 °P	15.00 °P	16.00 °P	
Taste	2.00	2.35	2.50	2.70	3
Smell	1.20	1.15	1.75	1.90	2
Color	4.20	4.40	4.80	4.80	5
Clarity	3.42	3.80	3.80	3.80	4
Foam	5.00	4.80	4.80	4.80	6
Full points	15.82	16.50	17.65	18.40	20
Evaluation	Very good	Very good	Excellent	Excellent	

4. Conclusion

The beer produced with the initial extract 16 °P meets all of the technological and economic conditions for production at J.S.C. “Birra Peja” brewery. The beer is of high quality, it is drinkable and has a satisfactory colloidal stability. The evaluation of testing analysis of beer produced of the 16 °P initial extract was graded

5. References:

1. Anger, H.-M.: **Brautechnische Analysenmethoden** (MEBAK). Weihenstephan, Freising, Deutschland, 2006.
2. Kunze, W.: **Technology Brewing and Malting**, VLB Berlin, Germany, 2004.
3. Nguyen, T. H., Viet Man, L. V.: **Using high pitching rate for improvement of yeast fermentation performance in high gravity brewing**, 2009.
4. Narziss, L.: **Die Technologie der Würzebereitung**, Stuttgart, Deutschland, 1985.