QUALITY OF A PILSNER – TYPE BEER STORED AT COOLING TEMPERATURE

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Abstract

Pilsner – type beer stored at temperature 4°C and 15°C was examined by sensory and physicochemical analysis.

Those analysis have shown that beer produced by one of the breweries in Poland had good physicochemical and sensory quality. Storage temperature and time have got an impact on canned beer quality. Storing beer for 4 weeks at temperature 15°C caused higher decline in quality than storing at 4°C. It has particularly concerned beer sensory attributes and the intensity of color and bitterness.

Keywords

Beer, sensory quality, physicochemical quality.

1. INTRODUCTION

Beer, as a low – grade alcoholic drink produced from barley, hop, malt, water and yeast, has been known for several thousand years.

Nowadays working breweries in the world amaze us with richness of their offers. They compete with each other for ideas. As the result they produce more original flavors which have diversed alcohol content. Birgi et al. [4] think that beer is not equal to another beer. In ancient times there was a considerable number of species and varieties of beer, therefore, the beer classification was created.

In Poland beer classification is defined by standard, according to which beers on Polish market divide into: types, kinds and groups. Due to fermentation conditions we can distinguish top-fermented beers (*Ales, Special, Wheat*) and bottom-fermented beers such as *Pils, Dortmunder* [8]. Presently bottom-fermented beers belong to the most popular and widespread beers in the world.

In consumer perception beer is a valued drink because of sensory attributes and good ability of slaking thirst. Nutritional (source of calories), dietary and vitamin value are also important elements of beer quality.

Beer energy value comes from alcohol, carbohydrates and proteins contained in it. On the other hand, nitrogen compounds, that are found in beer, trigger proteins and amino acids production which are necessary for the organism.

Beer is also a source of many vitamins of which the most important group is determined by B vitamins [1, 22]. It belongs to the valuable drinks because of hygienic and physiological properties. Therefore it is used in dietetics.

A method of a beer storage has got an important impact on its quality. A non – preserved beer should be stored at a temperature 2 – 10°C while preserved beer at 2 - 15°C [5, 11, 12].

The aim of our work was to determine pilsner – type beer quality during storage at temperature 4°C and 15°C in sealed cans.

2. MATERIAL AND METHODS

2.1. Material

Material which we used in our research was pilsner – type beer produced by brewery X in Poland.

We have taken 50 packs of beer sealed in cans, which came from one batch. The beer was pasteurized and its shelf life was 5 months. It was produced from malted barley.

Samples were divided into two parts: one part was stored at temperature 4°C, second one at 15°C. Beer analysis was performed after beer was ready to be sold (time 0) and after 1, 2, 3, and 4 weeks of beer storage in sealed cans.

2.2. Methods

Samples for physicochemical and sensory analysis were taken in accordance with standard [17].

The following analysis were performed:

- Determination of the effectiveness of pasteurization by PN – A – 79093 – 10 [14].
- Determination of frothiness which is pouring beer to the tasting glass at height 20 cm and then time measurement of foam maintenance.
- Determination of saturation with carbon dioxide by using descriptive analysis which is sensory statement of occurring saturation intensity [17].
- Determination of density by PN – A – 79120/03 [15].
- Determination of total acidity by PN – A – 79093 – 3/Apl:2002 [19].
- Determination of histamine content by PN – 87 - A – 86784 [13].
- Determination of bitterness content using spectrophotometric analysis by PN – A – 97093 – 12:2000 [18].
- Determination of color by PN – A – 79093 – 5:2000 [16].
- Sensory analysis using 6 - point scale [2].

We used following grading scale:

- 6 points – very good quality,
- 5 points – good quality,
- 4 points – medium quality,
- 3 points – sufficient quality,
- 2 points – only acceptable quality,
- 1 point - not acceptable quality.

Sensory analysis was performed by team which consisted of 5 – 7 persons, who had good sensory sensitivity [20, 21]. The results were averages from conducted evaluations.

Statistical analysis of the results was performed to test hypothesis whether storage at temperature 4°C and at 15°C had impact on sensory and physicochemical

changes in beer. Therefore significance of differences between particular variants of performed analysis were calculated.

The symbol α_{max} means that if significance level α is higher than α_{max} then regression index and correlation index at significance level α differ from zero. Thus the lower is α_{max} value the higher the probability that regression and correlation indexes differ from zero. Particularly, the value of $\alpha_{max} = 0{,}00000$ means that assessed parameter (regression index, correlation index) is significantly different from zero at any significance level higher that 0,00001.

Calculations were made using STATISTICA 7.1 and MS Excel 97 (Microsoft), which also used for drawing graphs.

3. RESULTS AND DISCUSSION

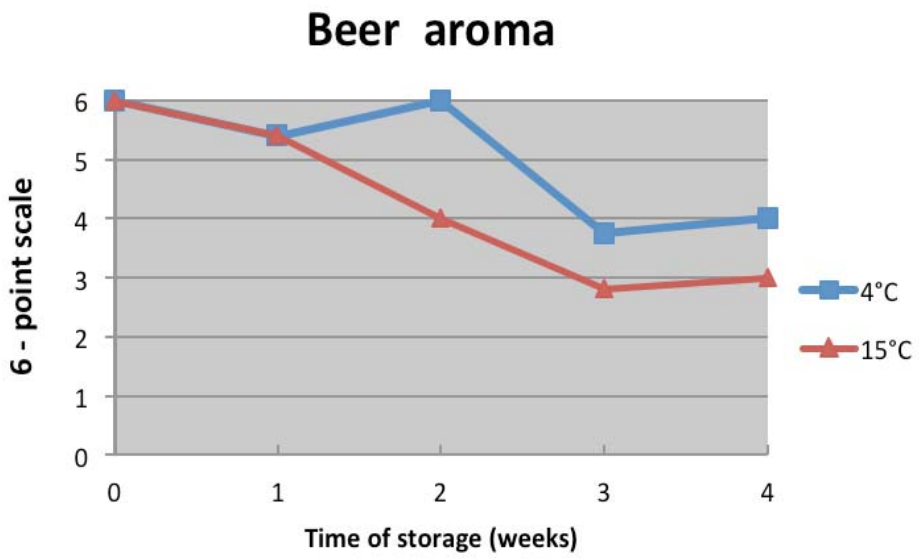
Pilsner – type beer, after it was ready to be sold, characterized with high sensory and physicochemical quality (Tab.1, Fig.1a, 1b).

Tab.1. Pilsner – type beer physicochemical indicators after it was ready to be sold

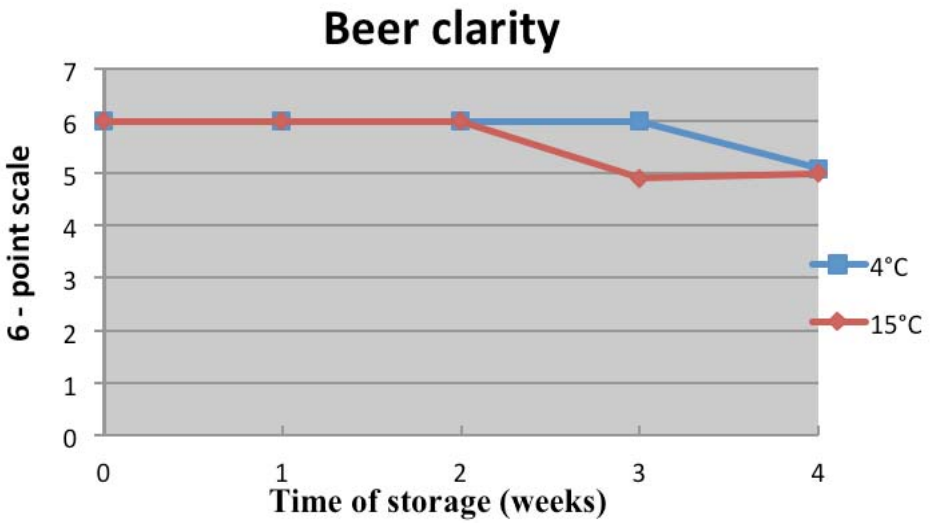
Product	**Test for pasteurization**	**Alcohol content [%]**		**Density [g • cm^3]**		**Sugar content [%]**		**Ash content [%]**	
		X	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Pilsner – type beer	Positive	5,69	0,02	0,9918	0	6,43	0,12	0,18	0

Kądzielski [9] thinks that beer is judged by consumer on the basis of appearance, taste and smell.

Bednarski and Tomasik [3] report that, nowadays most breweries produce beer which content is even while taking the following indicators into account: frothiness, saturation, clarity and bitterness. However, beers from individual breweries fundamentally differ in flavors that is taste and smell .


Beer aroma
6 - point scale
0
1
2
3
4
5
6
0
1
2
3
4
Time of storage (weeks)
4°C
15°C


Beer taste
6 - point scale
0
1
2
3
4
5
6
0
1
2
3
4
Time of storage (weeks)
4°C
15°C


Beer clarity
6 - point scale
0
1
2
3
4
5
6
7
0
1
2
3
4
Time of storage (weeks)
4°C
15°C

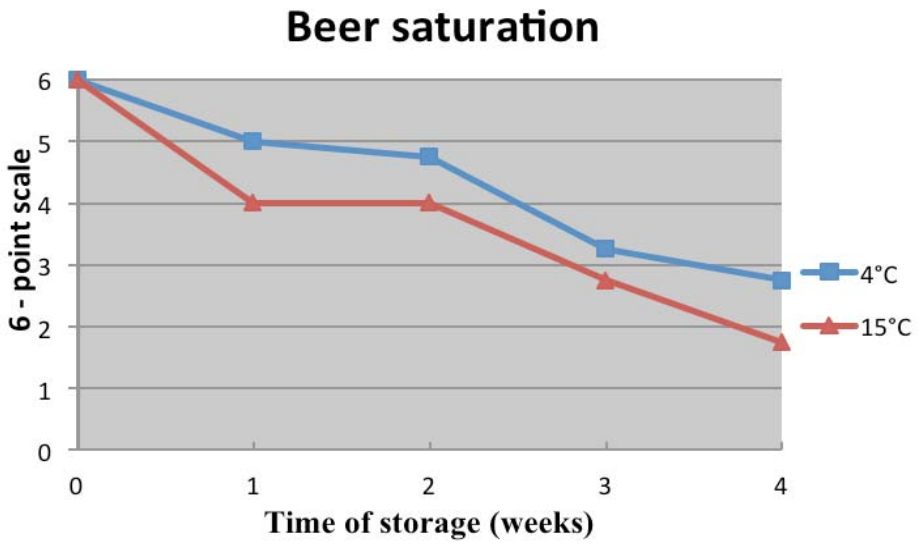


Fig. 1a. Pilsner – type beer sensory analysis stored in sealed cans at temperature 4°C and 15°C (aroma, taste, clarity)

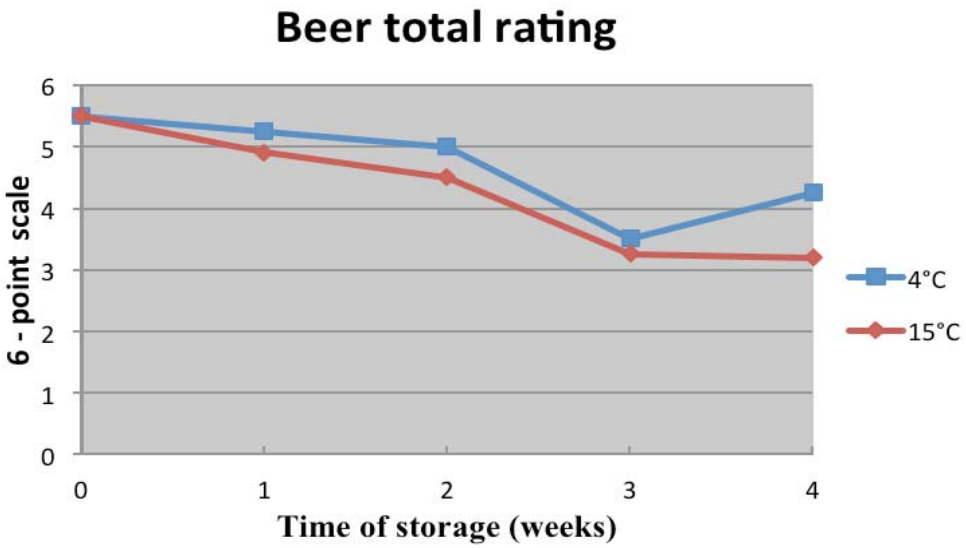


Fig. 1b. Pilsner – type beer sensory analysis stored in sealed cans at temperature 4°C and 15°C (saturation, total rating).

During beer storage in sealed cans at temperature 4°C and 15°C it was found decrease in its sensory quality. Particularly a high decrease in sensory quality was noted in beers stored at 15°C (fig.1a,1b), which could be caused by storing beer at temperature higher than 10°C.

Rosa and Komornicka [23] claim that many compounds including amines, specially histamine, are responsible for beer taste and flavor.

According to performed research after beer was ready to be sold the histamine content was relatively high: 2,52 mg•kg^{-1}.

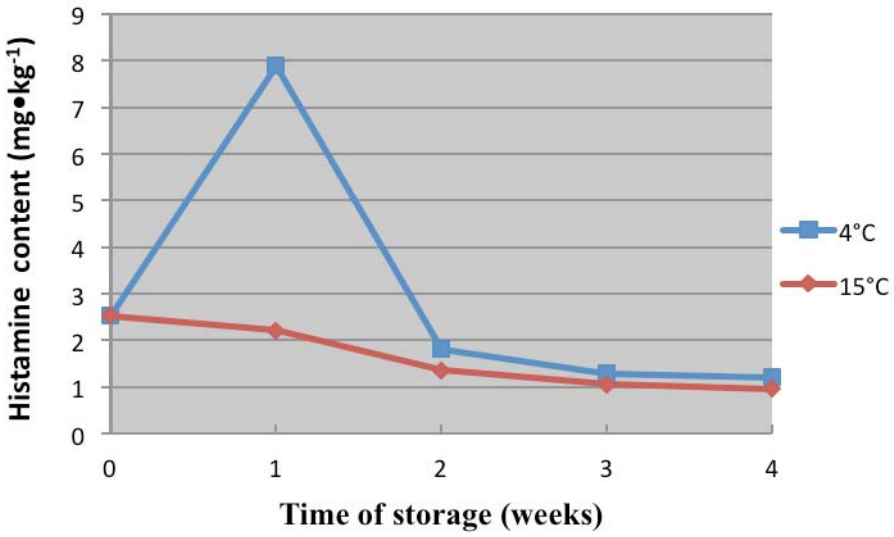


Fig. 2. Histamine content in pilsner – type beer stored in sealed cans at temperature 4°C and 15°C

Such high content could be caused by not observing technological process conditions.

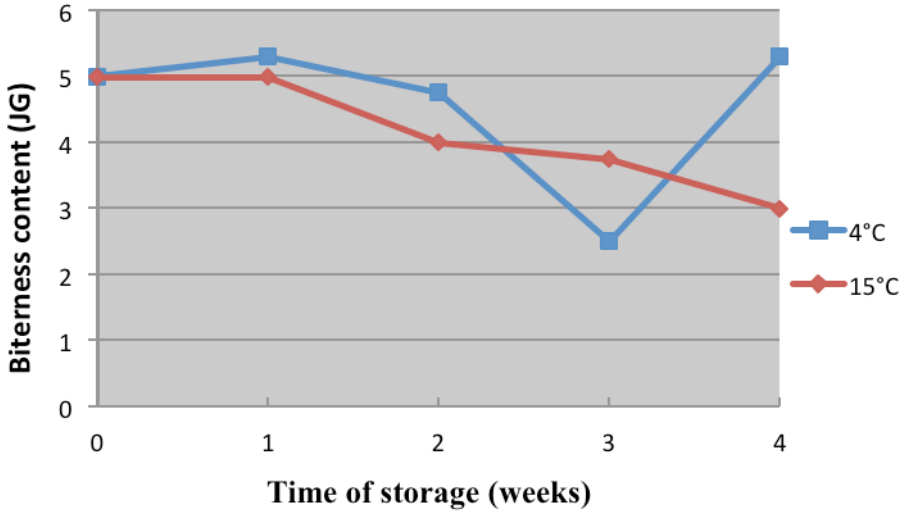


Fig. 3. Bitterness content in pilsner – type beer stored in sealed cans at temperature 4°C and 15°C

Materials and intermediate products used for beer production could also have impact on histamine content. It is said [3,24] that, histamine probably comes from hops cones or presence of milk acid bacteria (LAB) which are in adjustable yeast.

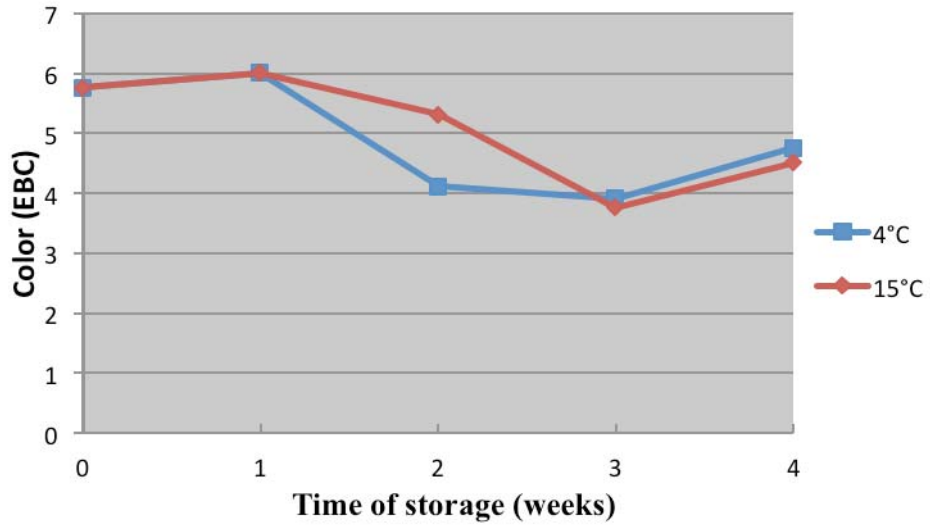


Fig. 4. Pilsner – type beer color stored in sealed cans at temperature 4°C and 15°C

Czerniejewska – Surma and Szulc's research [6] showed that the highest histamine content was in: hops, yeast, malt and wort.

According to fig. 3 and 4 pilsner – type beer had very high content of bitterness and color after it had been ready to be sold.

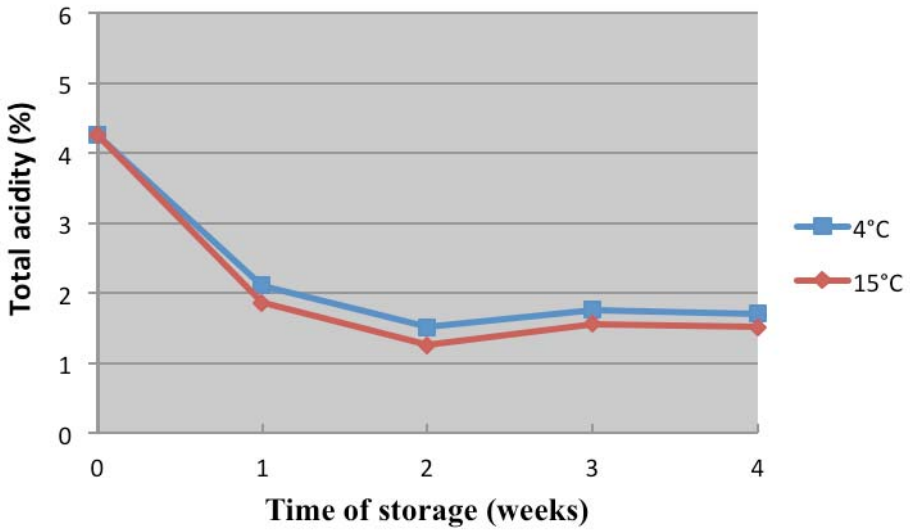


Fig. 5. Pilsner – type beer total acidity stored in sealed cans at temperature 4°C and 15°C

Kunze [10] says that most of the breweries produce beer which color is from 8 – 10 EBC units. Only few breweries produce beer which has very light color from 4,5 – 7,5 EBC units.

High pilsner – type beer quality was confirmed by total acidity results (fig. 5).

It was confirmed that time and storage temperature of beer in sealed cans had impact on its quality.

Beer storage in sealed cans at temperature 4°C and 15°C caused reduction in sensory and physicochemical beer quality.

Particularly great decrease of sensory quality was reported in beers stored at 15°C during 3 weeks. It concerned particularly beer aroma, taste, clarity and color (fig.1a, fig.4).

Confirmation for stored beer sensory quality decrease was bitterness content and color which were chemically determined (fig. 3,4).

As time passed during storage of beer sealed in cans gradual decrease in bitterness was noticed, especially almost 4 times in the third week (fig. 3).

It was observed that the color intensity of the beer stored in sealed cans decreased. There was slightly higher decrease in beers stored at 15°C (fig. 4).

Significant dependence was showed between time of beer storage at 4°C and 15°C and its color – accordingly for r = 0 ,95 and 0,92. Similar dependence was noticed for bitterness of stored beer at 4°C (r=0,88) and 15°C (r=0,86).

The research confirmed that storage temperature for beer sealed in cans has got impact on histamine content. Storage at 4°C and 15°C caused gradual content decrease of the analyzed amine (fig. 2).

After 4 weeks of storage at 4°C histamine content was lowered about 52% and at 15°C about 62% than original sample. Probably it was caused by microorganisms growth for which low molecular products from protein degradation, perhaps histamine, make a food source [7].

To sum up, storage method of beer sealed in cans may have an impact on sensory and physicochemical quality.

4. CONCLUSIONS

Obtained results allowed us to draw following conclusions:

1. Pilsner – type beer produced by brewery X in Poland had very good sensory and physicochemical quality.

2. Time and temperature of storage have impact on beer quality sealed in cans.

3. It was found that beer stored at 15°C had major decrease in sensory quality than beer stored at 4°C.

4. Pilsner – type beer storage at 4°C and 15°C caused decrease in color intensity about 1,5 and 2,01 EBC units.

5. After 4 weeks of storage at 4°C histamine content was lower about 42% and at 15°C about 60% than original sample.

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