

A new alternative to increase the flavor stability of the beer

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Introduction

The protection of the beer has been insured for many years through the treatment on colloids and the use of traditional anti-oxidant such as SO₂ and ascorbic acid, in order to comply with the market which requires 9 to 15 months stability. Such application comes usely from the maturation till the bottling line.

In order to optimise the organoleptic characteristics of the beer, the treatment in the brewhouse based on natural anti-oxidant has been studied, to inhibit the LOX activity and other oxydative fonction active in the wort. A study has been carried out to check the impact of such treatment on the wort and its enzymatic activities, based on tannin and classical antioxydants, with a global analysis of several lager and special beers.

The phenomenon of oxydation in the brewhouse and its implication

In the brewhouse, there are many steps that facilitate the oxydation : the grinding, the mixing, the mashing, as well as the ambient factors, mainly the temperature, the level of humidity. The quality of

the malt and the unmalted cereals is also a very important aspect of the final flavour stability. There are then many factors that would be brought, through a preventive application, to a standard quality very useful for the brewer.

The major problems due to oxydative conditions in the brewhouse are the presence of lipoxygenase and the coloration of the wort or the melanoidines oxydated. In the final product, we can also find a negative impact of the oxygen on the taste of the beer due to an auto-oxydation of the lipids, with a deviation of the ageing and the flavour stability.

Such situation comes gets accentuated by oxydation catalyst, principally the presence of heavy metals (Fe²⁺, Cu²⁺), high pH (>5,6), and the temperature during the mashing as well as the brewing diagram which can be responsible of a unefficient polyphenol extraction.

The practical solution to reduce the impact of an oxydated wort have been followed by the breweries, such as the use of modern machinery humid grinding, a very low agitation during mashing, the use desacerated water, an acid pH during mashing, by pumping the mash in from below. In the same time the quality of the malt is very evolutive according to the season, also according to its origin. It has been possible to identify a variation of the LOX between a Spanish malt (0.128), a malt from The Netherlands (0.305) or a malt from Great Britain (0.431) on the same year. Such aspects bring technical problems to standardise the quality of wort, consequently a stable quality of the bottled beer.

The innovative solution to bring a more stable wort and beer has been to introduce anti-oxidant during the mashing. Such technique would confer a reproductable quality of the flavor stability.

Tablet. Staling aldehydes formation during beer production (Walter,1996)

Here : Mashing and wort boiling

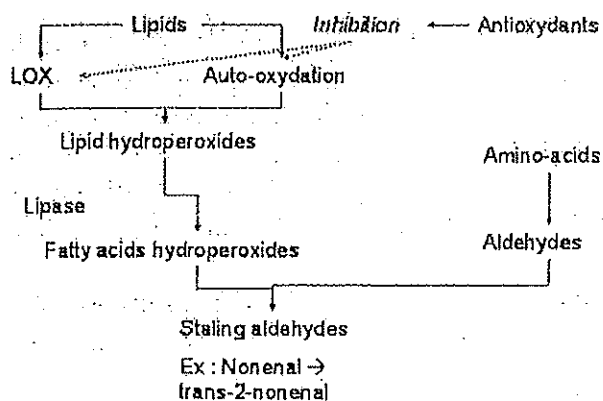


Fig 1.illustrates the objective of the anti-oxidant action

Table 1. Comparative analysis of tannin in beer

Characteristics	Proanthocyanidines	Gallotannins	Ellagitannins
Antioxydant	+/-	++	++
Reaction on proteins	+++	+	+
Adsoption of heavy metals	+	+++	++
Impact on color	Low	Low	Low

The possible products to be used are the tannin, the sulfite and the ascorbic acid. It becomes however necessary to check all the parameters of such introduction in the wort, such as the effect on the enzymatic activities of the wort, as well as the consequence that this treatment can have on fermentation, or the residual of such auxiliaries in the final beer.

Table 2. Wort analysis with and without anti-oxydant.

Wort treatment	No treatment	Antioxin [®] SBT
Turbidity EBC	42.0	43.8
pH	4.93	4.91
Color EBC	8.4	8.1
ITT sec.	264	132
Total sulfites before fermentation ppm	6.16	6.15

The additive solution to improve the flavor stability

In the beverage industry, a lot of studies have been developed on tannin application, which allows the following consideration for the application on beer wort :

The gallotannin, which seems to be the most effective potential anti-oxydant, needs to be complexed with traditionnal anti-oxydant to increase its effect on the wort. Together with metabisulfite of potassium and ascorbic acid, developed as Antioxin[®] SBT, the effect on lipoxygenase can be improved :

It looks very interesting to see that the addition of SO₂ in the preparation Antioxin[®] SBT could not be detected on the analysis before fermentation, so it has been considered that the ebullition allowed the elimination of the classical anti-oxydant, which follows the current European regulation on allergens.

Table 3. Impact of Antioxin[®] SBT on final beer

Final beer before antioxydant in bottling	No treatment	Antioxin [®] SBT
ITT sec.	112	20
Color EBC	10.3	8.5

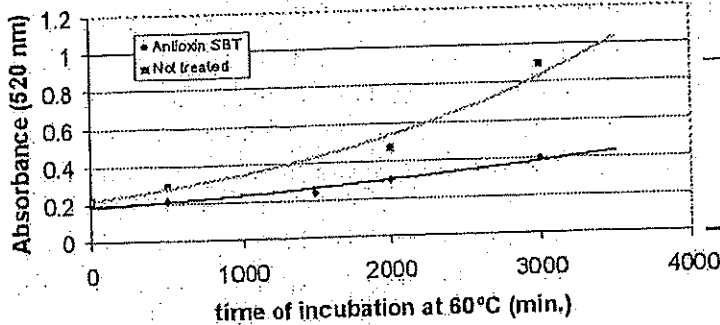


Fig 2. Analysis of absorbance increase according to the time of incubation at 60°C

Once the positive effect of Antioxin[®] SBT has been proved on the wort, it has been essential to check its impact on the final beer. Some laboratory analysis, completed with degustation from several beers in Western Europe allowed to

consider the following tendency :

Due to the influence of the addition of anti-oxydant during the bottling, on the ITT results after the forcing test, the RSV method (measure about the Aldehyde, lipids free radicals..) allows to measure the real anti-oxydative effect in the brewhouse.

Such results confirmed the easy identification of the impact of Antioxin[®] SBT in occasion the final degustation.

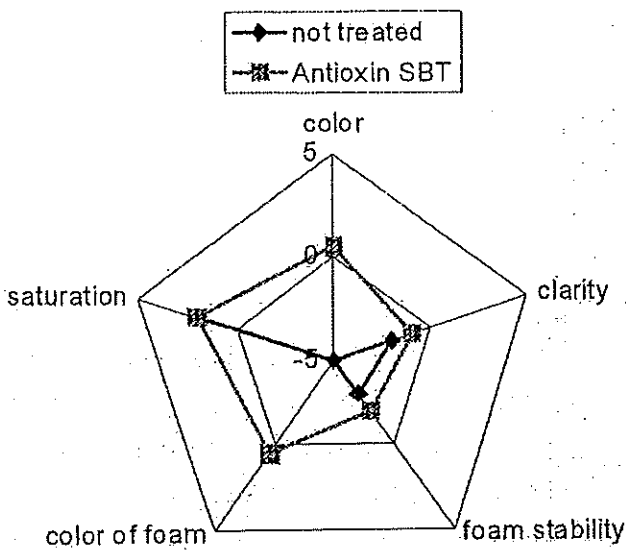


Fig. 3 Main aspects of the final beer

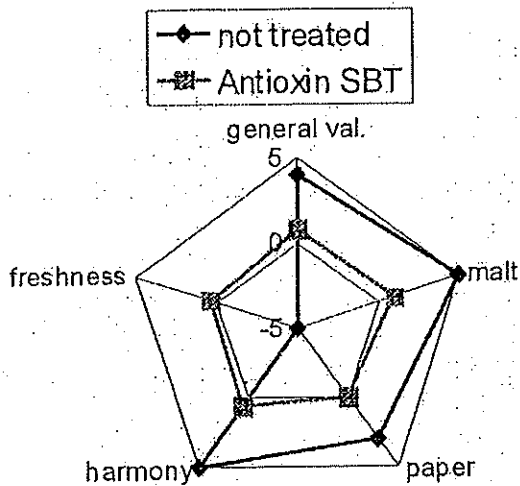


Fig. 4 Relevant aspects of beer flavor

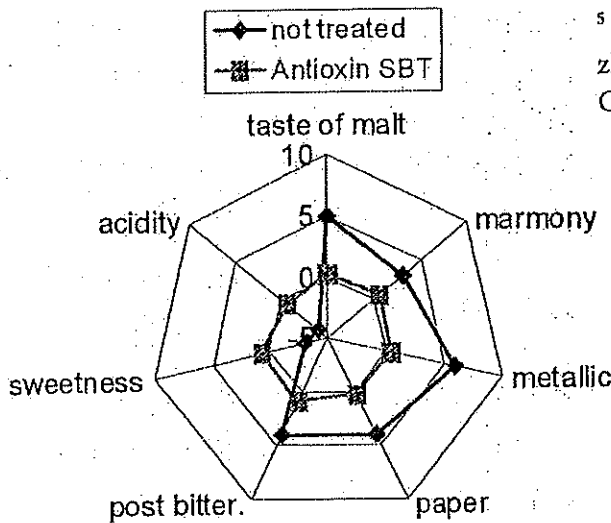


Fig.5 Relevant aspects of beer tasting after forcing test

Table 4. RSV method

Incubation min	No treatment	Antioxin® SBT
0	0.235	0.155
480	0.285	0.250
1440	0.345	0.327
1980	0.552	0.430
2880	0.855	0.625

Conclusion

This complete study allows to consider important arguments for the flavor stability of the beer. Indeed, the use of anti-oxidant in the brewhouse guarantees a better protection and standards of production, whatever the type of machineries and quality of raw materials. The complex studied with the addition of several anti-oxidant very quickly enlarge the impact on the wort and on the final beer, acting on oxygenases and sensible precursors of the malt such as melanoidines and polyphenols.

This additive solution will be highly recommended as a preventive action to improve the quality and the standardisation of freshness and ageing of the beer.

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