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Setting up of a method of pervaporation for improvingalcohol-free beer

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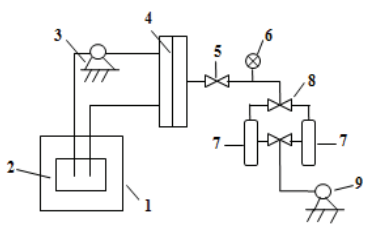
In recent years in Spain has witnessed a rise in the demand and consumption of alcohol-free due to driving restrictions, health reasons, etc. In 2010, 13% of the beer consumed in Spain (6,3 L per person) belonged to this variety (Cerveceros de España, 2011), and thus the country became a major producer and consumer of alcohol-free beer within the EU. However, the quality of alcohol-free beer cannot be highly rated since many flavours are lost during the manufacturing process. As a contribution to this sector, in this work we develop a method for recovering flavours from regular beer by pervaporation in order to incorporate them later to the non-alcoholic beer.

Pervaporation is a process used to separate one or more compounds in a liquid using semipermeable membranes in which the permeate exits as vapour in the permeate side where there is low pressure applied by vacuum, whereas the material retained remains in its liquid phase (Feng-Huang 1997). The permeated vapour is then condensed and would be reintroduced into de final product.



1. Thermostatic bath. 2. Feed tank. 3. Gear pump. 4. Membrane. 5. Valve. 6. Vacuum pressure transducer. 7. Cold tramp. 8. Three-way valve. 9. Vacuum pump.

Fig. 1. Pervaporation Diagram.

This method has been used in the food industry for wine dealcoholization (Catarino M. y Mendes A. 2010), to recover aromas from fruit juice (Figoli A. et al. 2009), etc. Some research has also been done on the aroma recovery of beers by pervaporation (Catarino M. et al. 2009)

The membranes used in the present work are hydrophobic membranes from Pervatech, consisting in a support layer of PET and a top later of Poly-di-Methyl-Siloxane (PDMS) with hydrophobic characteristics enabling high flux of organic components. The experimental device is described in figure 1, being the membrane in a flat sheet cell which provides a membrane active area A= 6.6 •10-3 m2(number 4).

As a first step, two liters of a synthetic solution of water-ethanol (5%) with three flavours (ethyl acetate, isobutanol and isoamyl acetate) were filtered in order to test the membrane and the process. The concentrations of the flavours were adjusted according to their presence in a typical market beer (30 ppm, 24 ppm and 1.25 ppm, respectively). Samples of feed, retentate and permeate (at 2, 4 and 6 hours of filtration process) were taken to analyze the flavours and ethanol content. After that, two different kinds of regular beers manufactured in Spain (with 5.5 and 6.5 alcoholic degrees) were processed following the same procedure as with the synthetic solution. Samples were analyzed by gas chromatography, and a remarkable increase in the concentration of the three different flavours in the permeate was noticed. In all cases (synthetic solution and beers), the highest increase in the concentration occurred after 2 hours of filtration

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with ethyl acetate presenting the highest concentration, followed by isoamyl acetate and finally by isobutanol. For the first beer, a comparison between the chromatograms of feed, retentate and 4-hours permeate is shown if figure 2.

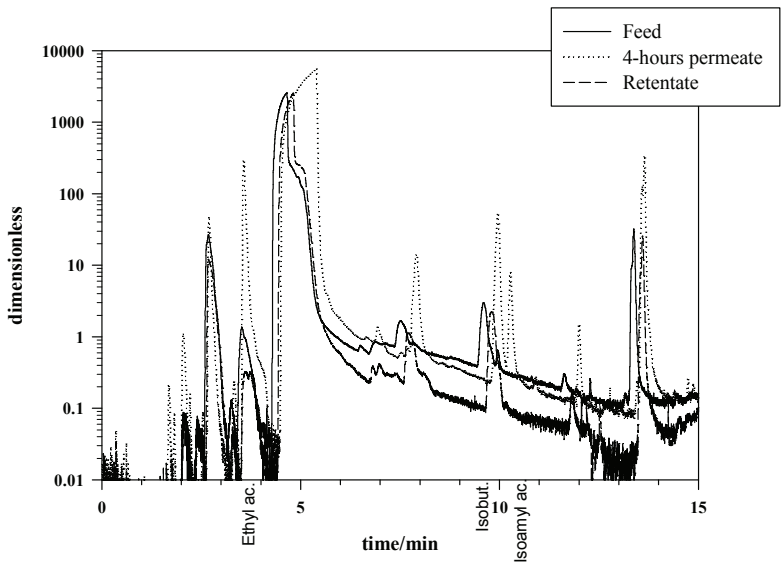

Fig. 2. Chromatograms for the 5.5º beer

Following these results, the next step will be the addition of the flavour permeated to alcohol-free beers, and to test how this flavour improves them. Although more research is needed the results obtained up to now show that a good recovery of the main aromas with a low passage of alcohol is possible.

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