

Abstracts from Other Journals

This section contains summaries of recent papers published in a number of other Journals considered of interest to our readers, as well as a selection of patents that have been applied for or recently granted. If you would like to serve as an abstractor for the Journal of the Institute of Brewing, please contact Richard E. Wheeler.

R.E.W.

ABSTRACTORS FOR THIS ISSUE

I. Campbell, F. Jack, I. Russell, G. Stang, G.G. Stewart and R.E. Wheeler

1) Beer – Composition

Environmental contaminants in hops. R. SCHMIDT, P. ANDEREGG, and M. BIENDL (*Monatsschrift für Brauwissenschaft* 56, No. 5/6, 93 and 96–98, 2003).

The occurrence of unwanted environmental contaminants in hops, such as metals, mycotoxins and radionuclides has been analysed within the framework of sample screening of the 2002 hop crop. The analyses for metals included examination of the levels of the toxic heavy metals lead, cadmium and mercury, together with the harmful “half metal” arsenic. The amount of the metals detected in the hops does not have any impact on beer, as the resulting concentrations anticipated in beer were lower than the thresholds quoted in the Drinking Water Ordinance. Furthermore, the hops were found to contain lower amounts of lead and cadmium than reported in lettuce. Neither aflatoxin nor ochratoxin A were traceable in hops. The radionuclides Cs 137 and Cs 134 were detected in one test series, but only on a very low level. The results show, that the introduction of heavy metals, mycotoxins and radionuclides via hops into beer lies far below the hazard limit for human health.

G.S./R.E.W.

2) Brewing – Fermentation

Effect of mashing-in temperature on free amino nitrogen concentration and foam stability of beer. M. CVEN-GROŠCHOVÁ, G. ŠEPEL’OVÁ, and D. ŠMOGROVI-COVÁ (*Monatsschrift für Brauwissenschaft* 56, Nr. 7/8, 128–131, 2003).

Low mashing-in temperature (37°C) and long duration of resting (60 min. including mashing-in) and a long time of heating up to 63°C, leads to a very high amount of FAN – up to 270 mg/L in 12°P wort, but to very poor foam stability of the beer produced (220 seconds in average) due to a low amount of high molecular proteins. When mashing-in temperature was higher (63°C) the FAN concentration of 12°P wort was found to be only 162 mg/L, but foam stability of the beer was higher – 268 seconds on average. A mashing-in temperature of 50°C leads to a respectable

FAN concentration. Yeasts utilised 104 mg/L of FAN on average using 13.5°P wort with initial FAN concentration of 235 mg/L; 90 mg/L of FAN using 12.5°P wort (initial FAN – 219 mg/L) and 87 mg/L of FAN using 10.5°P wort (initial FAN – 197 mg/L).

The decrease of FAN levels was examined during the maturation process. The FAN content also dropped due to the blending of the beer with deoxygenated water by an automatic HGB system, to give the desired final gravity. FAN content in the finished product varied from 85 to 106 mg/L for 12°P beer, and from 70 to 94 mg/L for 10°P.

G.S./R.E.W.

Heat treatment of kieselguhr in order to improve filtration properties and for recycling. W. RUSS, N. SCHMID, and R. MEYER-PITTROFF (*Monatsschrift für Brauwissenschaft* 56, No. 7/8, 134–140, 2003).

Heat treatment can be used for the recycling of used kieselguhr from deep bed filtration. Heat treatment at 500°C for 120 minutes in the presence of water vapour improves the filtration properties of the recycled kieselguhr. The cumulative increase in pressure across the filter bed of the pilot filter, as a parameter for the maximum duration of filtration, rose more gradually over time with recycled material. The total amount of filtration time increases, therefore reducing filter down time. The turbidity, as a measure of filtration precision, does not increase. The water value and the permeability both increase with heat treatment. The particle size distribution indicated that structural changes as a result of the heat treatment were not common. The specific surface area and the pore volume of the kieselguhr was reduced by one third and the pore surface area, by 70%. Additionally, the average pore diameter was almost doubled. The decrease in filtration pressure, together with the higher values for turbidity both resulted from a change in pore size and a reduction in the adsorptive characteristics of the particles due to the heating process. Heat treatment presumably caused a reduction in smaller pores. Only the larger pores remained open, which lowered the resistance of the filter bed, increasing the flow rate through it. As a consequence, the filter bed compressed more slowly, which resulted in a more gradual pressure increase during filtration. Measuring the flow, the zeta potential and the amount of specific

charge, all proved that the adsorptive properties of the particles were reduced because of their diminished surface area and their reduction in surface area charge.

G.S./R.E.W.

Increasing beer ester levels through variation in wort composition and mashing procedures. M. HERRMANN, W. BACK, B. SACHER, and M. KROTTENTHALER (*Monatsschrift für Brauwissenschaft* 56, No. 5/6, 99–103/106, 2003).

Different studies have shown that fermentation in cylindrical-conical fermentation tanks leads to low ester levels in beer. This can result in a one-sided flavour profile particularly in wheat beers, but also in Märzen and Festbier, and in alcohol reduced beers and in light beers. Fermentation experiments conducted in a bio-reactor with varied parameters such as sugar composition, pressure and convection, showed that increased pressure reduces ester formation and thus, the fermentation tank height has a great impact on ester formation. Studies in terms of sugar composition in wort suggest, that as a result of reduction in maltose levels, ester levels increase in beer. In fermentation experiments on a small scale (10 L) with bottom and top fermenting yeasts, the ester level was found to be influenced by variation of the sugar ratio. In order to influence the glucose/maltose sugar ratio, a special mashing procedure was developed which supports maltase activity. This procedure, which is described in detail, conforms to the “purity law”, and can be conducted in any brewery. Experiments on a pilot plant scale (60 L) with different barley and wheat malts, have shown that the amount of ester in comparison to the “Hoch-Kurz-Maischverfahren” (high temperature, short time mashing process) can be increased 3-fold. An additional benefit of the new mashing procedure is the destruction of beta glucan.

G.S./R.E.W.

Activation of soluble-inactive limit dextrinase and its application. X. HUANG (*Monatsschrift für Brauwissenschaft* 56, No. 7/8, 132–133, 2003).

Most limit dextrinase exists usually in the inhibited form following malting. The transformation of this inhibited enzyme to the free and uninhibited enzyme was examined, by the control of aeration in germination, and the results compared to those of malt that was aerobically germinated and that was stored before beer production. It was shown that there was potential to improve the utilization level of soluble-inactive limit dextrinase and to receive other benefits as well.

G.S./R.E.W.

Carbon starvation can induce energy deprivation and loss of fermentative capacity in *Saccharomyces cerevisiae*. E. THOMSON, C. LARSSON, E. ALBRS, A. NILSSON, C.J. FRANZEN, and L. GUSTAFSSON (*Appl. Environ. Microbiol.*, 2003, 69, 3251–3257).

Most studies concerning microbial processes have considered analysis of cell metabolism during growth of the organisms. In their natural environment, however, microorganisms such as *Saccharomyces cerevisiae* spend most of their time under non-growing or very slow-growing conditions. Slow growth or stationary phase is usually due

to severe limitation of one or several nutrients. Knowledge of the physiology of *Saccharomyces cerevisiae* under such conditions is very limited and almost exclusively confined to aerobic conditions. Consequently, the response of *S. cerevisiae* to starvation under anaerobic conditions is an almost completely unexplored field. Seven different strains of *S. cerevisiae* were tested for the ability to maintain their fermentative capacity during 24 h of carbon or nitrogen starvation. Starvation was imposed by transferring exponentially growing cells to a defined growth medium lacking either a carbon or a nitrogen source. After 24 h of starvation, fermentative capacity was determined by addition of glucose and measurement of the resulting ethanol production rate. The results showed that 24 h of nitrogen starvation reduced fermentative capacity by 70–95%, depending on the strain. Carbon starvation provoked an almost complete loss of fermentative capacity in all of the strains tested. The absence of ethanol production following carbon starvation occurred even through the cells possessed substantial glucose transport capacity. Similar uptake capacities were recorded irrespective of whether the cells had been subjected to carbon or nitrogen starvation. The prerequisites for successful adaptation to starvation conditions are probably gradual nutrient depletion and access to energy during the adaptation period.

G.G.S.

Effects of furfural on the respiratory metabolism of *Saccharomyces cerevisiae* in glucose-limited chemostats. I.S. HORVATH, C.J. FRANZEN, M.J. TAHERZADEH, C. NIKLASSON and G. LIDEN (*Appl. Environ. Microbiol.*, 2003, 69, 4076–4086).

An important problem in fermentative conversion of lignocellulose to ethanol is the severe inhibitory effects often exerted by lignocellulosic hydrolysates. Furfural is a characteristic compound present in dilute acid hydrolysates, particularly in hydrolysates from deciduous woods. Effects of furfural on the aerobic metabolism of *Saccharomyces cerevisiae* were studied in a chemostat. The kinetics of furfural conversion were analysed. It was found that furfural concentration in the bioreactor was close to zero at all steady states obtained and furfural was exclusively converted to furoic acid during respiratory growth. A metabolic flux analysis showed that furfural affected fluxes involved in energy metabolism. During both aerobic and anaerobic growth, the ability to tolerate furfural appears to be directly coupled to the ability to convert this compound to less inhibitory compounds.

G.G.S.

Heterologous expression of the *Saccharomyces cerevisiae* alcohol acetyltransferase genes in *Clostridium acetobutylicum* and *Escherichia coli* for the production of isoamyl acetate. C.E. HORTON, K.-X. HUANG, G.N. BENNETT, and F.B. RUDOLPH (*J. Ind. Microbiol. Biotechnol.*, 2003, 30, 427–432).

The technology of producing natural flavourings from microorganisms will prove to be very useful to food, perfume and beverage industries. An advantage of producing flavour compounds such as esters via microbial fermentation is the elimination of chemical synthesis. Esters are formed by the condensation of acids with alcohols. Alco-

hol acetyltransferase is one enzyme responsible for the production of esters from acetyl-CoA and different alcohol substrates. The genes *ATF1* and *ATF2*, including alcohol acetyltransferases from *Saccharomyces cerevisiae* have been sequenced and characterized. The production of acids and alcohols in mass quantities by the industrially important bacterium *Clostridium acetobutylicum* makes it a potential organism for exploitation of alcohol acetyltransferase activity. Expression of the *S. cerevisiae* alcohol acetyltransferase genes in *Escherichia coli* and *C. acetobutylicum* demonstrated the ability of these organisms to make use of a foreign gene and produce new compounds such as acetylxyylan esterases. Although *ATF2* appears to be redundant in yeast, both genes have applicability for exploring metabolic flux in *E. coli* and *C. acetobutylicum*. However, controlled pH during fermentation would be necessary for *C. acetobutylicum* to produce sufficient quantities of the ester for this to be a feasible option for mass ester production.

G.G.S.

3) Microbiology

A modified *Saccharomyces cerevisiae* strain that consumes L-arabinose and produces ethanol. J. BECKER and E. BOLES (*Appl. Environ. Microbiol.*, 2003, 69, 4144–4150).

Bioethanol is an alternative to fossil fuels, either as a pure fuel with high efficiency and performance, or as a gasoline additive. An attractive feedstock is cellulosic biomass. Cellulosic biomass is a complex mixture of carbohydrate polymers and hydrolysates and will contain hexoses and pentoses, including glucose, galactose, mannose, D-xylose, and L-arabinose. A *Saccharomyces cerevisiae* strain has been engineered to utilize L-arabinose for growth and to ferment it to ethanol. Following over expression of a bacterial L-arabinose utilization pathway consisting of *Bacillus subtilis* AraA and *Escherichia coli* AraB and AraD and simultaneous over expression of the L-arabinose-transporting yeast galactose permease, an L-arabinose-utilizing yeast strain was selected following sequential transfer in L-arabinose media. Molecular analysis of this strain has revealed that the crucial prerequisite for efficient utilization of L-arabinose is a lowered activity of L-ribulokinase. Moreover, high L-arabinose uptake rates and enhanced transaldolase activities favour utilization of L-arabinose. This yeast strain should be useful for efficient fermentation of hexoses and pentoses in cellulosic biomass hydrolysates.

G.G.S.

Effect of different starvation conditions on the flocculation of *Saccharomyces cerevisiae*. E.V. SOARES and A. VROMA (*Journal of Applied Microbiology*, 2003, 95, 325–330).

It has been suggested that flocculation could enhance yeast survival under starvation conditions. Although the specific suggestion was not investigated that lysing cells could more readily provide nutrient for the others when located within clumps, the effect of starvation was studied

with a highly flocculent strain of brewing yeast, NCYC 1195. Cells were incubated at 25°C with orbital shaking over 48 h in either water (i.e. no nutrient), yeast nitrogen base without carbon source or 2% glucose in deionised water (i.e. no nutrient other than carbon source). In water or YNB, no change in cell number was observed and the yeast remained fully flocculent. In glucose solution, cells became non-flocculent over the period of incubation, and doubled in number. Other fermentable sugars (galactose and maltose) caused a similar effect, but cells did not multiply and remained flocculent in ethanol solution, a non-fermentable substrate. The loss of flocculence seemed to be an energy-requiring process influenced by carbon metabolism and required *de novo* protein synthesis, necessarily from endogenous sources under the imposed starvation conditions. However, when similar experiments were carried out with a constitutive *FLO1* laboratory strain of *S. cerevisiae* (S646-1B), that strain retained its flocculence in glucose.

I.C.

Biomonitoring of process yeasts by fluorescence optical methods in practice. Part IX: Trehalose – Stress protectant of *Saccharomyces* strains. K.-J. HUTTER, C. KLIEM, F. NITZSCHE, and M. WIESSLER. (*Monatsschrift für Brauwissenschaft* 56, No. 7/8, 121–125, 2003).

In brewing practice it is of importance to know the particular stage of the cell cycle during which yeast generates trehalose under stress conditions as a protectant. Currently, there are no methods available (preferably on-line) to determine trehalose levels for process modelling and yeast propagation respectively. The aim of this investigation was to extend the physiological analysis spectra with a fast direct fluorescence optical detection for trehalose. A rise in temperature during the stage of exponential growth caused an immediate trehalose accumulation in the yeast cells, which has been detected by both HPLC and fluorescence optical analysis.

G.S./R.E.W.

Small molecule activators of sirtuins extend *Saccharomyces cerevisiae* lifespan. K.T. HOWITZ, K.J. BITTERMAN, H.Y. COHEN, D.W. LAMMING, S. LAVU, J.G. WOOD, R.E. ZIPKIN, P. CHUNG, A. KISIELEWSKI, L. ZHANG, B. SCHERER, and D. SINCLAIR (*Nature*, 2003, 425, 191–196).

This paper reports on the discovery of three small molecules that activate sirtuins (a family of enzymes known to extend the life span of yeast). They showed that the potent activator resveratrol, a polyphenol, lowered the Michaelis constant of SRT1 for both the acetylated substrate and NAD⁺, and increased cell survival by stimulating Sir 2, increasing DNA stability and extending life span by 70%. Researchers found that yeast cells treated with small doses of resveratrol lived for an average of 38 generations, compared to 19 for the untreated yeast. The polyphenol worked through a known sirtuin molecular pathway to help yeast cells survive environmental stresses. Since yeast and humans share many genes, scientists have speculated there may be a similar effect in people. It is speculated that sirtuins may buy cells time to repair damage.

I.R.

4) Sensory evaluation/consumer research

The path analysis method of eliminating preferred stimuli (PAMEPS) as a means to determine foam preferences for lagers in European judges based upon image assessment. J.A. SMYTHE and C.W. BAMFORTH (*Food Quality and Preference*, 2003, 14, 567–572).

This paper describes a new method, the “path analysis method of eliminating preferred stimuli” (PAMEPS), for determining consumer preferences for different types of lager foam at various stages during consumption. Judges were presented with images of various levels of head and lacing in full, half-full and empty beers and asked to indicate their preferences at each stage. This gave a virtual “preference path” of their most preferred foam characteristics during consumption. They were then asked to repeat the processes as if this preferred path was no longer available, but any other combination of foam characteristics could be selected. The top five preference paths were collected from each judge. Four different populations were tested (Belgian, Finnish, Irish and Scottish groups). Results confirmed that foam characteristics are important attributes, with consumers from different geographical locations preferring different levels of head and lacing. The characteristics of the full-glass beers had the greatest influence on preference. However, although later stages were less influential, judges did appear to prefer the level of foam to remain constant throughout consumption. Overall this method was demonstrated as being a useful and rapid means of carrying out such evaluations.

E.J.

5) Beer – Packaging

Examination of the permeability of crown corks and PET bottles to volatile organic substances, using a naphthalene model. G. MÖLLER-HERGT, R. SCHORN, H.-J. WATERKAMP, K.-H. HOPPE, and H.-J. RODERFELD (*Monatschrift für Brauwissenschaft* 56, No. 5/6, 90–92, 2003).

Ever since it was established that trichloroanisole can diffuse through the plastic sealing of beverage packaging materials, the problem of potential contamination of beverages by volatile organic substances was recognised. Inadequate storage, combined with poor permeability of the sealing materials can result in the migration of undesirable substances into beverages. A simple and precise method to determine the permeability of sealing materials within crown corks and screw closures, as well as PET bottles and their closures, and of two-piece or multi-part can sealing has been developed, using naphthalene as a substitute for other non-polar, organic substances. Major differences in permeability were observed when testing crown corks with different types of sealing materials. Plastic beer bottles also showed major differences in their permeability to naphthalene.

G.S./R.E.W.

6) Patents issued and patent applications

The following sampling of abstracts from recently issued patents and patent applications were selected from the United States Patent and Trademark Office Website

(<http://www.uspto.gov/patft/>) and from Europe’s Network of Patent Databases (<http://gb.espacenet.com>). Full patent information is available at these sites (online and at no cost) if more details are desired.

High soluble dietary fibre fermented beverage and process for its production. M. BRIER, J.K. SHETTY, and A.W. KING, Genencor International Inc., Palo Alto CA (*United States Patent Application 20,030,167,929, Sept. 11, 2003*).

The invention is directed generally to a brewing process for producing a product which contains a high content of soluble dietary fibre. This fibre is preferably produced enzymatically from the digestible sugars ordinarily part of the brewing process. It is possible to produce above about 0.3 g/100 ml, preferably about 0.5 mg/100 ml and preferably above 0.7 g/100 ml of additional soluble dietary fibre via this process. The lower amount of soluble dietary fibre produced may have a taste effect on the product that may be desirable, particularly when coupled with reduced digestible sugar content.

I.R.

Low lipoxygenase 1 barley. A.C. DOUMA, A. DODERER, V. CAMERON-MILLS, B. SKADHAUGE, L.M. BECH, N. SCHMITT, J.C. HEISTEK, and J.R. VAN MECHELEN, Merchant & Gould PC, MN (*United States Patent Application 20,030,167,544, September 4, 2003*).

This invention is in the field of plant biotechnology. Barley plants having reduced lipoxygenase-1 enzyme activity are provided, for example, barley plants expressing mutant LOX-1 protein. The barley plants of the invention are useful in the production of plant products such as malt and brewed beverages, particularly beer, having increased stability and reduced T2N potential. More specifically, the invention relates to a mutant barley lipoxygenase 1 gene (lox-1) that encodes an enzyme with severely reduced 9-hydroperoxyoctadecanoic acid forming activity. The invention also relates to the use of barley cultivars homozygous for lox-1 in brewing processes to reduce the formation of off-flavours in brewed products, such as beer, during storage.

I.R.

Product and process of making a protein, vitamin, mineral and antioxidant fortified sport beer. E.T. DONHOE (*United States Patent Application 20,030,157,218, August 21, 2003*).

A process is provided for the preparation of a sport beer or malt beverage that has enhanced nutrition, in comparison to existing beer or malt beverages. The beverage comprises a beer or malt beverage that contains supplemental protein, peptide, amino acid, antioxidant, mineral and/or vitamin supplements. Such a beverage provides a healthier alternative to conventional beer or malt beverages, especially when consumed in post recreational sport social contexts.

I.R.