

SUMMARIES PRESENTATIONS
31st EBC Congress, Venice - 2007
(names of presenters are written in CAPITALS)

LECTURES

THE BREWING INDUSTRY AND THE EU: FUTURE PERSPECTIVES

L01 Moderate is the message

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MBE - Consultant

SUMMARY

Attitudes to personal health have changed fundamentally across Europe in recent years. The political process is looking with ever more careful scrutiny at beer and its consumption. The industry is now laying much more emphasis on measurement and evidence. The Weinberg report was part of this industry evolution. In the coming months the brewing industry is going to face some very tough decisions across a range of issues. This presentation focuses on what is being done to counter emotive pressure group campaigning through the commissioning of research such as the Weinberg report, partnering with internationally renowned academics on the public policy process and maintaining/developing the reputation of beer.

L02 The future for the European brewing industry

Ulf SPENDRUP
President The Brewers of Europe

SUMMARY

This most traditional industry, as the breweries represent, is undergoing dramatic changes. Owners change, distribution patterns change and the legislation affects our industry from various angles. Being a brewer in Europe in general and a medium one in Scandinavia particular, is the content of my speech. Alcohol in beer has become an issue all over Europe. We must deal with that, regardless of our participation in the misuse of beer. Our future commitment to beer and society might be an important factor to maintain the brewery status and the brewer's status within our local and national communities.

L03 The impact of technology on the brewing industry

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SUMMARY

Brewing industry has developed tremendously during the last 30 years in terms of product quality, production efficiency, productivity and environmental impacts. Technical improvements in production technology, equipment development, automation and process design and control have facilitated up to five fold increase in volume output per man hour, sometimes doubled the capacity utilisation of the existing breweries with marginal capital investments, halved the new capacity investment hl-costs and reduced the losses and utilities usage considerably. At the same time product quality consistency and stability has improved due to better process control. Past, present and future issues will be discussed.

L04 R&D in brewing: the importance of underpinning knowledge

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SUMMARY

Brewing is often described as a blend of art and science; yet, for probably, greater than 98 % of its history, brewing was purely an art. The development of the brewing industry mirrored developments in technology in general and allowed for large-scale consistent production. This was underpinned by knowledge of biochemistry, microbiology, organic and analytical chemistry. Recent consolidations in the brewing community have markedly affected the amount and type of R&D being carried out. Future brewing R&D will certainly be different from that in the last 150 years but will nevertheless continue to add significant benefit to both producer and consumer.

L05 A global need for a renewed emphasis on technical education in brewing

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SUMMARY

Today's emphasis on being a cost-effective producer of quality malt beverages implies the rigorous application and constant monitoring of key performance indicators (KPIs) across the supply chain. In brewing, the necessary drive towards continuous process improvement by these metrics must be in unison with the development of sound problem-solving skills in tomorrow's master brewers. Enhanced technical interpretation combined with strong business acumen will ultimately contribute to higher quality, "right the first time" and, therefore, an improved cost base. This text examines how changes in the "rules of the game" demand a re-focus on technical education in brewing and how alternative options by educational providers offer solutions with either face-to-face, distance learning or blended learning formats.

PRODUCT DEVELOPMENT

L06 Cereal based foods to improve well-being and reduce risk of metabolic syndrome related diseases

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SUMMARY

Intake of both cereal dietary fibre and whole grain is increasingly shown to protect against rapidly expanding chronic diseases such as cardiovascular disease and type 2 diabetes. The protection is suggested to be due to concerted action of dietary fibre and various bioactive compounds such as lignans, phenolic acids, alkylresorcinols, phytosterols, folates, tocopherols and tocotrienols, other vitamins and minerals. These compounds are concentrated in the outer layers of the grain, and are often removed in pearling and milling processes. Technologies are needed to better exploit the diversity of grain raw material, and are developed in EU project HEALTHGRAIN.

This study is financially supported by the European Commission in the Communities 6th Framework Programme, Project HEALTHGRAIN (FOOD-CT-2005-514008).

L07 Influence of beer matrix in respect to drinkability

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SUMMARY

Drinkability of beer is definitively promoted by a good harmony between the different beer ingredients and aroma compounds. The main contribution to the bitter flavour of beer is due to isohumulone. It is known that components of the beer matrix like alcohol content, dextrin, pH and proteins have influence on the bitter taste and the drinkability of beer. The paper shows the influence of different substances of the beer matrix on the bitter taste threshold. In addition to a human taste panel the “taste sensing system SA402B (Intelligent Sensor Technology, Inc./Japan)” is used to evaluate the bitter impression.

L08 Aroma release from beer; dynamic mechanistic studies

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SUMMARY

The release of aroma compounds from beer before drinking plays a major role in the overall perceived flavour of beer. Release is dynamic and driven by a variety of physical factors (e.g. partition coefficient, air flow conditions) as well as chemical factors (composition and interactions). On-line mass spectrometric volatile analysis was used to measure aroma release from model systems, over a range of alcohol contents (0 to 15 % ABV), to understand the relative contributions of the physical and chemical factors. The results can be used to predict the effects of changing alcohol content on aroma release.

L09 Development of new plant extracts rich in hop polyphenols

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SUMMARY

Investigations were started to develop methods for isolating beneficial polyphenols from hops. As a result two new types of extracts were developed. One is mainly consisting of prenylflavonoids (main ingredient is xanthohumol). This product is not soluble in water but in ethanol. The other extract is water soluble and rich in glycosidically bound polyphenols (multifidol, quercetin, kaempferol). Each of both hop products could constitute an innovative ingredient of functional food or food supplements. A non-alcoholic beermix containing the extract rich in xanthohumol is already on the market. To overcome its water insolubility a food grade emulsifier is added.

L10 Medical properties and brewing technological limits of xanthohumol enriched beer

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SUMMARY

Roasting substances have high xanthohumol enrichment potential that may be increased by optimization of roasting. In our experiments use of optimized roasted malt increased xanthohumol contents in final beer. Moreover, this beer was characterised by high sensorial quality. Downstream addition of xanthohumol enriched roasted malt beer results in adequate products comparable to conventionally xanthohumol enriched dark brews. Brewing technologically enriched xanthohumol contents now reach concentrations in beer shown to be effective in rat experiments. Xanthohumol can simply be dosed in every production step via concentrated xanthohumol enriched roasted malt beer. Resulting beers can be filtered and stabilized without significant xanthohumol losses.

L11 Transfer of potent hop odorants linalool, geraniol and 4-methyl-4-sulfanyl-2-pentanone from hops to beer

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SUMMARY

To study the impact of linalool (flowery, citrus-like), geraniol (rose-like) and 4-methyl-4-sulfanyl-2-pentanone (black-currant-like) on the flavour of beer, their concentrations were determined in hops of five varieties and in corresponding beers brewed with two hop additions (60/40). Results showed transfer rates around 40 % for linalool, which corresponded to the late added hop portion, and somewhat lower values for geraniol. In contrast to geraniol, linalool clearly exceeded its flavour threshold in the beer samples, corroborating its importance for the hoppy aroma note. 4-Methyl-4-sulfanyl-2-pentanone, the characteristic odorant of Cascade hops, was also effectively (63 %) transferred to beer in aroma-active amounts.

L12 Functional drinks and phytopharmaceuticals based on beer and medical herbs

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SUMMARY

Beer and medical herbs traditionally used in folk medicine can serve as a basis for developing a wide variety of products with specific physiological activity. Depending on the nature and the content of the active ingredients, these products can be classified as either functional beverages or as phytopharmaceuticals. The paper gives an overview of the potential of different medical herbs to serve as sources of active ingredients for functional drinks and beer-based phytopharmaceuticals. It deals with the sensorial evaluation of the final products, determination of the bioactive substance content, the potential therapeutic actions, and the recommended dosages.

PRODUCT SAFETY

L13 The EBC/Brewers of Europe Food Safety programme

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SUMMARY

In recent years, ensuring and demonstrating the safety of our food supply has become a major issue in Europe. Reasons include the advancing globalisation of food companies, certain high profile food-based health problems such as new variant CJD, the discovery of heat-generated toxins and the Commission's focus on mycotoxin legislation. Safety of beer remains central to the strategic vision of newly amalgamated EBC/The Brewers of Europe organisation. This lecture will explain how The Brewers of Europe food safety programme operates and will present findings from one of the first research projects to be commissioned by the new group, an investigation into the behaviour of *Fusarium* mycotoxins T-2 and HT-2 during brewing.

L14 Fate of naturally occurring aflatoxins during brewing

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SUMMARY

Our study surveyed the carry-over of aflatoxin B₁ during the brewing of lager beers in a brewery owned by a major company in Italy and determined the extent to which AFB₁ can tolerate the brewing process. The AFB₁ level in maize varied from 0.3 to 14.85 µg/kg and from 0.005 to 0.022 µg/kg in finished beer. A range of AFB₁ from 0.59 % to 3.33 % was retrieved at the end of the production chain. The amount of AFB₁ in percentage of that present in the liquid phase, was 74 at lautering, 46 at boiling, 34 at whirlpooling, 32 after fermentation. The contribution to the diet of a moderate daily consumption of beer can be considered irrelevant for the consumer's health.

L15 Evolution of *Fusarium* population on French brewing barley

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SUMMARY

We have assessed a large scale study of *Fusarium* population in French brewing barley over the past 4 years. We have observed an increase in the barley samples containing TCTA. Actually, this contamination (toxin, visual and PCR identification) grew up dramatically from 2002 to 2006. A change in the *Fusarium* population balance has occurred in France. Nevertheless, presence of process resistant mycotoxin (e.g. heat or pressure) being due to field contamination, they can be conserved in foodstuffs.

L16 Effects of time, temperature and humidity on acrylamide generation during thermal processing of partially kilned malt: an on-line mass spectrometry study

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SUMMARY

The effects of process temperature and humidity on acrylamide generation in pale malt samples was followed using a 'real-time' mass spectrometry technique. Generation of acrylamide was strongly temperature dependent (increasing over the range 140-200 °C) and exhibited a short induction phase, a rapid increase to maximum and subsequent decay. This time-course represents a balance between generation and decay (due to depletion of acrylamide precursors and to thermal decomposition or addition reactions of acrylamide). Increasing environment humidity stimulated acrylamide formation pathways. This research aims to identify conditions which minimise the acrylamide content of malt whilst retaining the desired flavour characteristics.

L17 Detection of mycotoxins in malting barley by electronic nose

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SUMMARY

There is a need for rapid detection methods of mycotoxins in malting barley. An electronic nose was used to study ochratoxin A contamination (discrimination limit: 3 ppb) in barleys. The best model was validated with around 250 samples. 84 % of the samples were classified in the right group (5 % of false positive, 4 % of false negative). These results show that the electronic nose, with correct statistics, could be useful for the evaluation of mycotoxins in barley.

L18 Biogenic amines and N-nitrosamines control in beer production chain

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SUMMARY

Biogenic amines and nitrosamines control in food is not yet effective. They need a better traceability through all the whole chain production. The main objectives are to set-up and optimise innovative analytical methods to monitor nitrosamines and biogenic amines in brewing production chain. A method for the simultaneous determination of biogenic amines and a sensitive procedure for determining 4 N-nitrosodialkylamines (dimethyl, diethyl, dipropyl and dibutyl) are described. Moreover, the main critical steps have been identified to reach a better knowledge on the origins of these contaminants and how they can be controlled.

L19 A competitive R5-ELISA for measurements of hydrolysed barley and wheat prolamins: analysis of beers

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SUMMARY

People who suffer from celiac disease cannot include wheat, barley or rye in the diet. Thus, this population cannot drink beers because these are based on wheat and barley. Previously, one of the main problems has been the difficulty to measure hydrolysed barley and wheat prolamins in beers. We have developed a competitive ELISA, based on the monoclonal antibody R5, capable to quantify hydrolysed prolamins in beers, with a sensitivity of 3 ppm. Recently has been commercialised the first Spanish beer based on barley malt (Estrella DAMM) “suitable for celiac” with levels of prolamins lower than 6 ppm, as determined by the competitive ELISA.

TECHNOLOGY & ENVIRONMENT

L20 Information Technology as a supporter to increase the availability of filling and packaging plants

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SUMMARY

Based on latest scientific results a detailed view of today's serviceable IT applications and future solutions for the optimization of packaging plants will be given. Performance tests and production data showed plant utilisations from 50 to 70 %. About one half of the downtimes have organizational reasons. Of the technical downtimes the major part belongs to interactions within the complex lines that need to be detected by diagnosis tools. Line efficiency could be increased up to 5 % by a new continuous control concept and noise emissions could be reduced.

L21 Refillable use of diamond-like carbon coated plastic bottles for beer

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SUMMARY

Under the global attention to environmental issues, plastic bottles of polyethylene terephthalate (PET), polylactic acid (PLA), and polyacrylonitrile (PAN) were examined if they have basic requirements for refillable use for beer. The inside of these bottles was coated with diamond like carbon thin film to restrict gas permeation. Bottles were evaluated in terms of bottle strength, gas barrier property, and washability. PLA bottles lacked in anti-creep strength and seem unrealistic in use for beer. Both PET and PAN bottles can be candidates for refillable use when washing conditions are moderated.

L22 Permeation of volatile organic compounds (VOC's) through plastic bottles and closures of beverage and particularly beer

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SUMMARY

Alongside the advantages there is the problem of plastic's inherent permeability to gases and volatile organic compounds. However, there are no data available on permeation measurements of volatile organic compounds (VOC) through plastic bottles and contamination of beverages. Novel methods for the measurement of VOC have been developed. The presentation will show the new apparatus which enables the exposure of bottles in an environment that is enriched with defined concentration of solvents. The research results elucidate that the different barrier systems of plastic bottles show no sufficient guard for a permeation of VOC from atmosphere into the analysed liquid..

L23 An analysis of the total environmental impact of barley- malt-beer chain

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SUMMARY

Contributions of different processes to the total environmental impact of barley-malt-beer-chain were analysed in order to focus ecological improvements effectively. Daily beer consumption makes less than 0.5 % of the total daily per capita environmental impact. Barley production on farms makes 37 %, logistics, sales and consumption of beer together 32 %, brewing 19 %, and the rest of the processes 12 % of the total environmental impact of the beer production and delivery chain. Nutrient run-offs, primary energy consumption and energy related emissions dominate the total impact. Increasing crop yields and energy efficiency would effectively reduce the total environmental impact of barley-malt-beer-chain.

L24 Novel procedure for the recovery of CO₂ emerging at the alcoholic fermentation

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SUMMARY

During the alcoholic fermentation about 4.2 kg CO₂/hl cooled wort (KW) are emerging. Actually up to 2.8 kg can be recovered. This is not sufficient to meet the breweries' own needs of CO₂. In a co-work between Kronen AG and the Chair an improved recovery system was developed and installed. This system is based on a cooling cascade with CO₂ as cooling agent for a low temperature liquefaction. By this system up to 3.5 kg CO₂/hl KW can be recovered. The results show that the system is an attractive alternative to the commercially available procedures.

L25 Functional materials – a possibility to improve brewery hygiene?

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SUMMARY

Functional surface materials can reduce the attachment of microorganisms and dirt, and facilitate their removal in cleaning operations. We studied functional materials that could be useful in the brewing industry. Hydrophobic coatings proved to be less prone to microbial adhesion than stainless steel. Silver containing antimicrobial steels and photocatalytic TiO₂ coatings were able to reduce the microbial load in production environment. The most effective materials were active for several months. These coatings withstood the mechanical and chemical wear of production conditions well. Thus, functional coatings could be applied to microbiologically susceptible sites in the beer production and distribution chain.

L26 Optimizing the CIP-cleaning of surfaces

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SUMMARY

Each year there exist huge losses in food and beverage industry because of long time or insufficient cleaning. Therefore the experiments of this study investigated the influence of a surface (surface energy and the surface finish), of the contamination and of the cleaning agents on the cleaning result. The results of this study can save money for the producing industry as they effect the economy of purchase of brewing equipment. Another benefit is that the adaptation of the cleaning agent to the contact partners can become optimised, which means economical advantages as well as ecological ones.

L27 The influence of a disc stack centrifuge on beer quality

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SUMMARY

Hydrodynamic stresses imposed on *Saccharomyces cerevisiae* cells during beer processing have a detrimental impact on beer quality and subsequent stability. The use of centrifuges has become a popular way to increase brewery throughput as their use decreases clarification times. The effect of a disc stack centrifuge on beer physical stability has been investigated. In this study, a commercial ale strain has been subjected to different operating conditions during centrifugation. A relationship has been established that mannan, an unfilterable haze constituent, is released from the yeast cell wall as a function of centrifugation cycles compromising beer physical stability.

WORT BOILING

L28 Engineering fundamentals of the wort boiling process

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SUMMARY

Many mistakes about the evaporation process are circulating. One mistake is, that brewers do not distinguish between the different types of evaporation, although the calcination of flavours underlies different mechanisms at an atmospheric boiling of wort or at a flash evaporation. Therefore the basics of a boiling process will be explained. This includes answers on the questions: Why does wort boil? What is a vapour-liquid-equilibrium? What is the difference between atmospheric boiling and flash evaporation? The knowledge of these basics brings many vantages to people of the brewing section. Brewers do not have to take allegations for granted anymore.

L29 Explanation of the differences in the evaporation efficiency of common wort boiling systems

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SUMMARY

An important function of wort boiling is the calcination of flavours, whereas the efficiency of the evaporation of flavours can differ at varying wort boiling systems. The different evaporation mechanisms that underlie the different boiling systems were researched. Based on the evaporation basics, residue curves were established for every common wort boiling system. This residue curves have been confirmed with experimental decreasing values of flavours during the boiling of wort in various boiling systems. It is now possible to characterise the different boiling systems and to predict a needed over all evaporation individually for every brew in every boiling system.

L30 Innovative wort production in relation to 21st century wort boiling and optimised beer flavour quality

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SUMMARY

The new concept focuses on the optimisation of milling, mashing, mash separation, shortest heat load, shortest vessel occupation times, efficient stripping starting at mashing-in and total cost reduction. The proposed innovative brewing line consists of a hammer mill (CO₂ protected), a premasher equipped for stripping, heating by direct steam injection, a thinbed filter, two vessels, one for mashing-off at high temperature and one for combining “wort boiling” and hot wort clarification. The design is based on earlier experience with regard to control LOX reactions, heat load reactions, release and stripping of volatiles, effect of hopping and control of sparging operations.

L31 Thermosyphon external wort boiling and its impact on flavour stability

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SUMMARY

Very large surface area external wort heaters allow the use of very low steam temperatures compared with internal heater. This results in reduced heat load on the wort and improvement in the flavour stability of finished beer. From breweries with brew sizes up to 1200 hl, tests were made on both wort and finished beer. Thermosyphon external wort heaters with a very high heater surface area to wort volume ratio are beneficial to finished beer in terms of flavour stability.

L32 Wort boiling - the Meura concept with wortstripping

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SUMMARY

Combining industrial performances and energy savings is a key factor for every brewhouse. An efficient but more economical and ecological wort-boiling/clarification system will be presented. This general concept optimises trub and volatile formation and their removal while improving the OBY. It features: a “formation” vessel, a wort-settling tank and a stripping column. Results from an industrial brewhouse performing wort-stripping at 600 hl/h will be exposed. The very good matching of the concept with a continuous brewing philosophy will be demonstrated. Such industrial installation for 200 hl/h high gravity wort (3 Mios hl beer per year) to be commissioned in 2007.

L33 Interdependence between wort boiling and wort treatment and their influence for producing high quality wort

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SUMMARY

To describe the interdependence between wort boiling and wort treatment after the last “hot” process step the whirlpool, the influence of different intensities of heat transfer during wort boiling were analysed. Data were collected for the two wort fractions (first and second wort), also as for the total wort fraction.

The described combination of wort boiling and wort treatment process is a technology which gives the brewers a very flexible instrument to adapt the process to all necessary variations of raw material and product profiles.

RAW MATERIALS

L34 Marker assisted development of isogenic lines carrying different alleles of the β -amylase I gene and the analysis of their malting quality

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SUMMARY

Isogenic lines representing the identical genetic background, differing in the four recently identified β -amylase alleles will elucidate if thermostability of β -amylase can improve malting quality of barley. Donors of four β -amylase alleles were crossed to a spring barley variety. The progeny was backcrossed twice with the recurrent parent and subsequently selfed twice to obtain homozygosity. In each generation the progeny was subjected to marker analysis using a pyrosequencing-based SNP marker. Results of the malt analysis from kernels grown in field trials will illustrate the influence of the particular alleles on malting quality. Application of single enzymes to improve quality is discussed.

L35 Oxylipin cascade enzymes and their impact on beer quality

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SUMMARY

One of the most important issues in modern brewing is how to produce flavor- and foam-stable beer. (2E)-Nonenal and trihydroxyoctadecenoic acid, two important oxylipins in beer, deteriorate the flavor and foam stability of beer. During past years, we have shown that barley enzymes are involved in the production of these oxylipins during mashing. In this study, we for the first time identified the pathway, enzymes and genes (3Z:2E-isomerase and HvHPL2) for the production of (2E)-nonenal. Present study contributes not only to the brewing science, but also to the development of malt varieties or barley cultivars for producing flavor-stable beer.

L36 Identification and elimination of germination inhibitors for the reuse of steep-out waters

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SUMMARY

The requirement to reduce water consumption and effluent generation in food industries has led maltsters to consider water reuse. Recycling steep-out waters into the steeping process resulted in deterioration of malt quality, due to the presence of germination inhibitors. Investigations were thus carried out and inhibitors identified. In order to eliminate them, a membrane bioreactor was used. At laboratory, pilot and industrial scales, it allowed an efficient elimination of the inhibitors and production of potable water. Treated waters were recycled into the steeping process, and resulting malts and beers were of satisfying physico-chemical and sensory qualities.

L37 A superior prediction of malt attenuation

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SUMMARY

The replacement of the diastatic power (DP) malt specification in favour of the measurement of the DP enzymes, α -amylase, β -amylase and limit dextrinase is evaluated. DP enzymes predict ~90 % of variation in malt attenuation compared to <50 % of variation by DP alone. The variation in the levels of these enzymes across more than 400 commercial malt samples is illustrated and the ramifications for malt blending, barley sourcing and brewing practices is discussed. For the brewing industry, the adoption of this concept is predicted to result in substantial improvements in brewing consistency and enable more specific quality targets for barley breeders to be defined.

L38 The influence of the gelatinisation temperature of barley malt on the mashing process

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SUMMARY

The gelatinization temperature is an interesting starch characteristic of barley and malt quality. Due to hot and dry climate during vegetation the gelatinization temperature can significantly increase a lead to quality changes in the brewery. The extreme hot and dry summer 2006 showed that this climate provokes gelatinization temperatures above 65 °C. The results show how the gelatinization temperature is influencing wort quality when a standard mashing regime (62 °C β-amylase rest) and an adopted regime (rest at gelatinization temperature) is used. It could be demonstrated that the knowledge of the gelatinization temperature helps to adjust the mashing program.

L39 Isolation and characterisation of antifungal compounds from lactic acid bacteria and their application in malting

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SUMMARY

Fungi are an important problem in the malting and brewing industry, due to their ability to produce mycotoxins on the field, during storage as well as during the malting process. In this paper for the first time, antifungal compounds from malting / brewing Lactic acid bacteria have been characterised at a molecular level and their effectiveness proven in pilot scale malting trials. Challenge trials using *Fusarium* species revealed that the strains inhibited the fungal growth during malting, as well as improving the malt quality. The interaction between the starter strains and fungi were studied using scanning electron microscopy.

L40 Correlation of deoxynivalenol, hydrophobins and gushing

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SUMMARY

The phenomenon of beer gushing is still a problem of worldwide importance. The determination of the gushing potential of malt is complicated and different methods are available, however, all tests have deficiencies and the “real” gushing-factor is unknown. Deoxynivalenol and hydrophobins are considered as gushing indicator and gushing factors, respectively. The correlation of deoxynivalenol, hydrophobins and gushing was determined, a simple and precise gushing test was developed and the gushing factors were investigated by enzymatic methods and characterised by HPLC, IEF, SDS-PAGE and LC-MS. The new gushing test gives maltsters and brewers a useful tool to estimate the gushing risk of malt.

L41 The effect of using polyphenolic extracts during mashing on the colloidal stability of beer

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SUMMARY

Focal point of this work was to evaluate the effect of using polyphenolic extracts, the waste product after hop extraction, concerning to the colloidal stability of the resulting beers. The used extracts induced better stability in the force test, but also better redoxpotential during mashing, faster lautering as well as a more differentiated polyphenolic spectrum compared to a reference beer without extract addition. So usage of these by-products during mashing can be regarded as an elegant and economic method to improve colloidal stability in a natural way and to produce beers with higher concentrations of nutritionally valuable phenolic substances.

ENZYMES

L42 Enzymes in food processing, a critical review

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SUMMARY

Enzymes offer specific means to modify the properties of food raw materials, ingredients or process wastes. Enzymatic reactions are generally very specific and can be carried out at mild conditions. Targeted processing with enzymes offers e.g. means to remove unwanted components from the process, to improve product yields or availability of bioactive components of the raw materials. Furthermore, enzyme-aided fractionation of valuable components from plant raw materials or process by-products can be utilized in developing novel value-added food ingredients from e.g. brewer's spent grain. In this work the use of enzymes in different food processes is reviewed.

L43 Enzymes in beer production – a European regulatory perspective

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SUMMARY

There is a long tradition of adding enzymes as processing aids during food production processes. Food enzymes must live up to the same high safety and purity standards as other food ingredients. The presentation will give an overview of the regulatory requirements for the use of enzymes in beer within the EU including a proposal for a new, harmonized EU legislation for food enzymes. Also the EU requirements for food enzymes from genetically modified microorganisms will be explained and the consequences for the brewing industry will be discussed.

L44 Is the use of technical enzymes necessary or are still enough natural enzymes available in malt?

Klaus HARTMANN

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SUMMARY

The enzymatic system of malted barley has the activity to solve the high molecular substances into low molecular weight substances. Breeding of new barley varieties makes it possible to control the cytolytic, amylolytic and proteolytic activity in the green malt to get the required malt quality. Special varieties are bred (low-LOX, thermostable enzymes etc.) to improve the wort and beer quality. The right combination of the malt quality and the mashing conditions allows to force or to stop single enzymic activity (the use of unmalted cereals is possible) to reach nearly every wort quality without technical enzymes.

L45 Studies of particle sizes in beer treated with a proline-specific protease which prevents chill-haze in beers

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SUMMARY

The effectiveness of Brewers Clarex™ in the prevention of (chill) haze in beer was demonstrated previously. More mechanistic understanding of beer stabilization with Brewers Clarex™ came from particle size analysis on (semi-)industrial scale beers, treated with silica hydrogel, PVPP and Brewers Clarex™. The average particle size of the Brewers Clarex™ stabilized beers was much smaller than that of beers stabilized with other methods. This small particle size could lead to elevated 90-degree scatter readings while beers were perfectly clear and stable, and may call for re-evaluation of the predictive value of 90-degree scatter readings for colloidal stability when Brewers Clarex is used.

L46 Beer flavour enhancement by using exogenous β -glucanases and β -glucosidases produced by Solid State Fermentation (SSF)

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SUMMARY

Flavour is the most important quality aspect of beer. The aromatic quality can be improved by controlling the microorganisms contaminations which are responsible of certain organoleptic deviations and by releasing flavour active compounds of beer by using respectively β -glucanases and β -glucosidases. The impact of these enzymes originated from a selected strain and produced by a Solid State Fermentation (SSF) in increasing the organoleptic quality of beer is discussed. The Glycosyl-Glucose (G-G) extracted from the beer substrates such as malt, hops, and spices are a source of aromatic precursors. The carbohydrates resulting from hydrolysis of G-G by yeast and exogenous enzymes are quantified.

L47 Process development for enzymatic starch conversion at high concentrations

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SUMMARY

During this research, alternative mashing processes for high gravity brewing were investigated. A model system consisting of wheat starch (50-70 w/w %), water and thermostable α -amylase was used during the experiments. Increasing the substrate concentration can affect several important system parameters. For example, the degree of gelatinisation decreases and the enzyme stability increases. These general statements were confirmed with experiments in an extruder coupled to a batch reactor. In addition, we found that the carbohydrate composition of the product was not affected by an increased substrate concentration. The results provide a basis for new industrial high gravity brewing processes.

YEAST & FERMENTATION

L48 A statistical tool to aid improvement of fermentation consistency

Behnam TAIDI¹, Jeff Hodgson¹, Hilary Jones¹, Jim Robertson², Greg McFarlane², Steve Bland², David Hopper², Kate Kemsley³, Marianne Defernez³, Rob Foxall³, Susan Ring³ & Gary Montague⁴

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SUMMARY

The work presented here aimed at developing a predictive tool that could forecast the end point of fermentations. The criteria for such tool were that no additional data would be required other than that which is routinely collected at brewing site and also that the prediction would be available prior to the time when top fermentation temperature was reached. The end of fermentation was defined as when both the target specific gravity and target vicinal diketone concentration would be reached. The model developed to predict when the specific gravity would reach the target value will be presented.

L49 Yeast distribution in cylindroconical vessels, new insights into fermentation performance and management

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SUMMARY

The progress of large scale fermentations is typically measured by off-line measurement of wort concentration. This assumes that during active fermentation vessel contents are homogeneous. Here is described, for three different lager strains, the results of monitoring of the distribution of viable yeast throughout a 1500 hl cylindroconical. Results are presented showing considerable heterogeneity for all strains throughout most of fermentation. The beneficial effects on yeast quality and process cycle time duration and consistency of management regimes which take this heterogeneity into account are described. Evidence is presented which casts new light on the relationship between yeast distribution and VDK metabolism.

L50 The regulation of flocculation by environmental stress and its application for predictive performance analysis

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SUMMARY

Freshly propagated yeast flocculate poorly compared to cropped slurries of generation 2 or more the reasons for these differences have not been elucidated. This paper will provide a holistic and full scale view of the regulation of cell wall changes and their impact on flocculation performance. Gene expression and functional analysis data from three brewery lager strains and one control laboratory strain for *FLO*, *CWP*, *DAN* and *TIR* genes during laboratory and full scale brewery fermentations will be presented. A model for the regulation of flocculation onset will be discussed in the context of normal and aberrant fermentations.

L51 Yeast flocculation: biology, chemistry and physics

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SUMMARY

This Critical Review will relate current findings of yeast genetics, cell wall surface and fermentation behaviour to brewing yeast flocculation. New findings from the authors' laboratory (including IGB and MBAA 2006 presentations as well as in press and submitted papers) will be related to the existing paradigm. Particular attention will be paid to the effect of fermenter shear on flocculation. A new downsized (15 mL) fermentation assay, which considers the effect of CO₂ evolution and fermenter height, will be discussed. New findings regarding Premature Yeast Flocculation will also be presented.

L52 Monitoring yeast physiology in brewery operations by frequent analysis of gene expression using TRAC methodology

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SUMMARY

Yeast adapts its physiology to changing conditions during brewery fermentations and handling mainly by transcriptional control. We followed expression of >70 genes through VHG fermentations by TRAC (Transcript analysis with aid of affinity capture), which facilitates frequent and accurate transcription analysis. Analyses up to 10 times a day showed extraordinarily dynamic changes in gene expression during wort fermentation. Expression of some important genes was too short-lived to be defined by less frequent analyses. The lag between change in gene expression and its physiological manifestation suggests TRAC may be useful to monitor and control brewery operations.

L53 Influence of yeast vitality and fermentation parameters on the formation of yeast metabolites

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SUMMARY

In many publications it has been argued that the physiological condition of yeast has an effect on the formation of yeast metabolites and it has been theoretically established. But there hardly has been any practical investigation to prove this point. In this study two sets of fermentations have been carried out with different yeast qualities. The fermentation performance was strongly affected by the use of lower quality yeast but the formation of aroma compounds has just been slightly affected. Nevertheless yeast vitality is a crucial factor for constant fermentation and high quality beer.

L54 Genomic analysis of yeast stress responses during industrial propagation and fermentation

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SUMMARY

Brewing yeast must be handled in such a way that subsequent fermentation performance is not compromised. Microarray analysis showed rapid, large-scale transcriptional changes in the yeast genome during brewery handling. A detailed examination revealed that the antioxidant response during brewery handling is unrelated to oxygen exposure and is, rather, dictated by yeast growth phase and nutritional composition of the wort. It is concluded that exposure to oxygen is not detrimental to yeast performance in the short term. This study highlights the usefulness of genomic technology in determining which stresses the yeast cell is exposed to during industrial brewery handling.

L55 Real time PCR screening and identification assays for beer and beverage spoilage yeasts

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SUMMARY

Detection and identification of spoilage yeasts in beer and beverages during the production process and in the product are an important issue. Rapid real time PCR assays for the detection of spoilage yeast were developed, situated on the rDNA and characteristic genes as targets. A combination of an universal yeast screening assay and a great variety of yeast species identification assays enables to the simultaneous detection and identification of spoilage yeasts. The assays can be combined and applied with regard to specific spoilage problems in the brewery. Detection levels, PCR-efficiencies and sensitivities of the assays were determined. All tested yeast samples from culture collections and breweries within the assay range could be detected and identified.

MICROBIOLOGY

L56 Diversity analysis of beer spoiling Gram-negative isolates using PCR fingerprinting and computer assisted analysis

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SUMMARY

Seventy two strains of *Pectinatus* and 2 strains of *Megasphaera* isolated from 10 brewery environments were analysed by Rep-PCR fingerprinting using three primer sets. The analysis was performed in order to study diversity and relatedness within each genus and to compare sources within and between breweries. On the basis of similarity to the reference strains, 21 out of 61 isolates were identified as *Pectinatus frisingensis*. The other 40 isolates are likely to belong to separate *P. frisingensis* lineages. Rep PCR is a simple, cheap, high resolution, rapid method for typing and identifying Gram negative, anaerobic, beer spoiling bacteria and is a useful tool in tracking and tracing microorganisms involved in beer infections.

L57 Critical review on detection and identification methods for brewery related microorganisms – new potential methods for rapid and exact identification

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SUMMARY

An overview of the state of the art detection methods for yeasts, wild yeast and beer spoiling bacteria is given, namely microscopy based on fluorescence probes, karyotyping and PCR techniques. These methods are used for different tasks like differentiation between brewers yeasts, closely related yeasts or detection of spoiling yeasts and bacteria. In addition new promising methods will be introduced. On one hand they are based on IR-spectroscopy, on the other hand on PCR combined with an HPLC technique. With the methods new opportunities are open to differentiate brewery related microorganisms up to strain level.

L58 Mechanisms of hop-adaptation in the emergence of beer spoiling *Lactobacillus brevis*

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SUMMARY

Their role in hop resistance and adaptation was studied with wild type and a hop adapted variant of *Lactobacillus brevis* TMW 1.465. Upon adaptation to hop, the metabolism changed for ethanol stress minimization and alternative energy generation, the divalent cation transporter HitA and the arginine deiminase pathway were induced, lipoteichoic acids were inserted into the cell wall, and the membrane fatty acid composition was altered. The acquired high hop resistance was energy independent and resided in a modified membrane composition and lipoteichoic fraction shielding from accompanying stresses and ensuring divalent cation maintenance. This work was supported by AiF-FV 14847.

L59 Role of manganese in beer spoilage - a revised view of hop resistance

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SUMMARY

Hop compounds, mainly iso- α -acids, were described as ionophores, which exchange H^+ for cellular divalent cations e.g. Mn^{2+} . However, the cellular concentrations of Mn^{2+} were similar after hop treatment for hop resistant as well as hop sensitive cells. Proteome analysis of hop resistant *L. brevis* revealed the overexpression of several manganese dependent enzymes, which can compete with the hop compounds for manganese binding and maintenance and thus enable survival. The ability of an *L. brevis* strain to regulate manganese balance appears to be crucial in hop tolerance and beer spoilage. This work was supported by AiF-FV 14847.

BEER QUALITY

L60 Development of new mashing-in technology to improve beer flavor stability

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SUMMARY

While mashing technologies have been developed to improve flavor stability, implementation is generally limited due to the costs and potential adverse effects. To overcome these problems, a novel mashing-in technology was designed by modifying the conventional facility. Under the optimized conditions, malt grist and hot water are mixed to denature undesired enzymes specifically, followed by the addition of cold water, which allows normal mashing diagrams. Chemical and sensory analyses confirmed the effectiveness of this technology on flavor stability, while no disadvantages were found in brewing performance and chemical properties. Therefore the newly developed technology is considered useful for extending freshness.

L61 Factors essential for the formation of 3-methyl-2-butene-1-thiol (3MBT) during wort boiling

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SUMMARY

3MBT has been cited as a substance causing “sunstruck” flavor in beer. 3MBT is a thiol compound generated when an iso-alpha-acid side chain cleaves due to exposure to light wavelengths of less than 520nm, subsequently reacting with SH radicals generated by sulfur amino acid. Recently, reports have indicated that 3MBT may also be formed during the brewing process, even in the absence of exposure to light. However, the mechanism by which 3MBT forms during the brewing process was not clearly elucidated. In this study, we have clarified the mechanism and factors contributing to 3MBT formation during the wort boiling process.

L62 Beervolt – a new equipment for the flow determination of diacetyl in beer

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SUMMARY

This work was undertaken, with the support of the Portuguese Agency for Innovation (AdI), with the objective of producing an equipment for the on-line determination of diacetyl and other compounds important for brewers. A first prototype was already produced and applied in the determination of diacetyl during the maturation of beer. The results have been compared with those obtained by the usual GC method. Although diacetyl and pentanedione cannot be distinguished with this method, in a practical point of view the method is faster and the results (end of maturation decision) are in good agreement with those obtained with GC.

L63 Sustainable redox power from beer proteins

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SUMMARY

Beer proteins promise sustainable reducing power. Proteins channel electrons from sulfite and other donors. Protein is a 'clearing house' for free radicals and ROS. Protein may also act as a sink for reactive molecules like aldehydes, and so limit their diffusion and reduce indiscriminate oxidation elsewhere. This provides short-term benefit. But normally staling compounds and carbonyls accumulate abruptly once SO₂ is exhausted and proteins are oxidised. Long term it seems preferable to retain functional protein and to extend the donor reductants (apart from SO₂) to sustain a protein electron flow. Is this possible within the limitations of the Reinheitsgebot?

L64 Enhanced long term stability measurement using a charge analyzing system

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SUMMARY

Long term stability is one of the most important quality criteria of beer. For its determination to date, only time-consuming methods exist such as the Forcier-Test. Alternatively, a new method (charge titration) has been developed to determine the particle charge of filtered beers, whereupon the relationship was elucidated between increase of clouding and decrease of potential along with advanced aging of beer. The results showed further that with increased particle size due to agglomeration, the total charge decreased linearly, which allows to make fast predictions about beer stability. Thus, alternatives to the Forcier-Test can be expected in the future.

L65 The Peroxide Challenge Test: a novel method for holistic, near-real time prediction of beer flavour stability

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SUMMARY

A holistic approach is paramount to reliably measure and predict beer staling. As a consequence, the Peroxide Challenge Test (PCT) was developed as an alternative to Electron Spin Resonance (ESR). The principle of the PCT is to mimic oxidation by titrating beer with hydrogen peroxide. The more H₂O₂ a beer can quench, the more resistant it is against oxidation and flavour deterioration. The PCT allows cost effective, near real time, high throughput assessment of beer flavour stability. The PCT is convenient and inexpensive to perform and the results correlate reliably with ESR measurements and the perceived aged character of beer.

L66 Application of optimized methods to determine the endogenous antioxidative potential of beer and other beverages

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SUMMARY

The Beverage Antioxidative Index (BAX-value) by using the EAP-determination with EPR-spectroscopy and an optimized analysis method for determination of the DPPH reducing activity, was employed to further analyse different factors which affect the oxidative stability of beer. With a focus by beer ingredients O₂, SO₂, metal-ion, ascorbic acid and specific brewing steps like brew house, filtration (cross-flow-membranfiltration vs. kieselguhr filtration), packaging materials (O₂-scavenger).

L67 A novel hybrid approach of detecting measurable coherences between the fluid flow of beer in the mouth and evoked sensory sensations

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SUMMARY

Sensory sensations concerning mouthfeel are basically characterized linguistically with the aid of trained sensory panels. In this context, the drastic influence of pure physical effects on sensory impressions during beer consumption is well accepted. Nevertheless, a possibility to describe mouthfeel quantitatively by means of physical measurements is missing so far. Thus, the current study deals with a novel hybrid approach that aims at quantifying the fluid mechanical aspects of beer consumption systematically. This topic includes the evoked mouthfeel as well as drinkability. Hence, the innovation consists in taking fluid flow as an impact factor on consumer acceptance into consideration.

BEER QUALITY

L68 Hop chemistry: new solutions to old challenges

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SUMMARY

Here, we describe the application of computational chemistry to the formation of and relative stabilities of humulene mono- and diepoxides which may be possible precursors to hoppy aroma if not contributors in their own right. Specifically, we have attempted to rationalise the proportions of the various epoxides formed by humulene oxidation, to understand the feasibility of more directed formation of specific epoxides for enhanced hoppy flavour control. Initial results indicate that it is the moderate selectivity of humulene epoxide A formation that drives the statistical distribution of the diepoxides that form subsequently.

L69 The impact of reduced vs. conventional hop extracts on beer flavour stability

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SUMMARY

The use of reduced iso-alpha-acids in brewing has become more widespread in past years, although their characteristics during beer ageing are not well known. Forced ageing in the absence of light had the strongest impact on conventionally hopped beers, followed by iso-alpha-extracts. Reduced isohumulones showed a significantly better stability with the tendency to improve from rho- over tetra- to hexahydro-isohumulone. Under light exposure, conventionally hopped beers were the first to show cardboard flavour, while beers containing only reduced hop products were virtually unaffected. The results indicate that the choice of hop products has a decisive influence on beer flavour stability.

L70 Temporal bitterness varies significantly among reduced and non-reduced iso-alpha acids in lager beer

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SUMMARY

A trained panel evaluated the bitter intensities of reduced and non-reduced iso-alpha-acids in an unhopped lager beer using a time-intensity protocol. Principle components analysis was applied to all temporal attributes, while concentration-dependant attributes were analyzed to determine equal-characteristic relationships. Accordingly, rho-iso-alpha-acids were less bitter and persistent with quicker dissipation than the other compounds. Tetrahydro-iso-alpha-acids and hexahydro-iso-alpha-acids were not different in peak bitterness from iso-alpha-acids, a result which challenges conventional wisdom that tetra is nearly twice as bitter as iso. Temporally, the bitterness from tetra was more persistent than the others.

L71 Draught beer quality - challenges and opportunities

D.E QUAIN

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SUMMARY

In the majority of European markets, draught beer is in long-term slow decline. Whilst numerous factors - political, economic, social and technical - have been implicated, poor beer quality has played a significant role in consumer dissatisfaction with draught beer. The challenge to raise the quality bar is being met by innovation from cellar to tap. This paper describes the numerous developments that range from the consumer (mystery shopper accreditation) to technology led such as improved product cooling, glassware that aids presentation, dispense tubing that deters biofilm attachment, better and assured line cleaning and the opportunities from real time, remote data logging.

POSTERS

BARLEY / BARLEY GENETICS

P01 The impact of environmental conditions on malting quality of barley from different locations in Europe

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SUMMARY

In recent year it became apparent that the climate has a significant impact on the gelatinisation temperature of barley starch. In light of the globalisation of the grain market it is important for the maltsters to gain as much information on the impact of location on the suitability of barley for the malting process. The objective of this study was to evaluate the impact of grain variety and location on malt quality. This study showed that cooler climates lead to lower gelatinisation temperatures. The results of this study can be used to select barley variety based on their amylolytic profile.

P02 Effect of the QTL located on the long-arm of chromosome 5H on the malt quality and seed dormancy

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SUMMARY

Quantitative trait loci (QTL)-analysis is a useful technique to clarify the genetic factors concerning various important traits. Twenty-nine strains on the pedigree of malting barley in Hokkaido island area were used to clarify the effect of quantitative trait locus, which was located on the long-arm of chromosome 5H (5H QTL), on the malt quality, enzyme activity and seed dormancy. Our results clearly showed the effect of 5H QTL on the characteristics investigated. This indicates that DNA monitoring is a powerful tool for estimating malting process suitable for a specific variety and gives efficient tools for malting barley breeding.

P03 Evaluation of the influence of steeping conditions on the antioxidant activity from barley to malt

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SUMMARY

By measuring the antioxidant activity of 3 varieties of barley at different pH values of water (5, 7 and 8) after the first steeping, relevant differences have been noticed. In spite of what is widely reported in the literature, in 2 out of 3 of the varieties analysed no statistically significant differences were found between pH 7 and pH 8 while in all experimental conditions the first steeping water at pH 5 has extracted polyphenols less efficiently. The antioxidant capacity of barley during all steps of malting shows a significant decrease that follows the first steeping.

P04 Relationships between β -glucans and protein in malting barley at increasing nitrogen fertilization levels

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SUMMARY

β -glucans may cause poor filtration during mashing. The accumulation of β -glucans and protein in barley grains was studied at field level. Three malting varieties, fertilised with increasing N levels (0, 50, 100, 150 kg/ha), were grown on an excessively drained soil. Crop biomass and leaf area were assessed at Zadoks GS 31, 61 and 92; grain protein and β -glucans content at the milk-dough stage and at maturity. In the unripe grains, β -glucans was inversely correlated with grain protein content, while at maturity they were positively correlated ($r = .601^{**}$). Our results are compatible with a different timing of protein and β -glucans deposition.

P05 Glucan production and glucanase activity – key parameters to improve the cell-wall modification of winter malting barley

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SUMMARY

The work provides an important contribution towards clarifying the physiological, enzymatic and genetic foundations for the cell wall modification of winter barley. New possibilities to improve the breeding of winter malting barley were outlined. The glucan production during grain maturation was analysed. The genes responsible were analysed using expression studies. Genotypes with low glucan contents were identified and suitable marker systems for breeders developed. The retarded production of glucanases and their unfavourable distribution within the germinating grain were identified as important causes for the poor cell-wall modification of winter barleys.

P06 A routine method for the differentiation of malting barley varieties equally applicable to grain and malt using multiplex PCR

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SUMMARY

For differentiation between barley species, a multiplex PCR application was developed. The analysis delivers constant banding patterns for raw barley and malt regardless of the year of harvest, the locality of cultivation and the process of malting itself. Grouping and differentiation of brewing barley varieties traded in Germany and their distinction to winter barley varieties was achieved. The analysis is equally applicable on raw barley and malt independent from growth factors. The spectrum of varieties will be continuously expanded, including new breeds as well as varieties from overseas. Further primer optimisation using molecular markers will improve single variety testing.

MALT / MALTING PROCESS

P07 Beta-glucan and arabinoxylan distribution in barley and malt

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SUMMARY

Beta-glucans and arabinoxylans are major constituents of both aleurone and starchy endosperm cell walls. Their impact on brewing process and beer quality has been demonstrated several times. In this study, their distribution within the grain and changes occurring on malting were shown thanks to microscopy and immunolabelling techniques using monoclonal antibodies. Both polysaccharide distributions have been observed in aleurone and endosperm cell walls. After malting, β -glucans have totally disappeared in endosperm whereas some remnants can be observed in the aleurone layer. Arabinoxylans are still present especially in the aleurone layer suggesting that they are not extensively degraded.

P08 The effects of modified atmosphere in malting

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SUMMARY

Nitrogen gas was applied during the air rest in steeping with the aim of controlling heat production. This procedure was compared to air recirculation. Moreover, nitrogen gas was applied at the beginning of kilning to suppress fungal growth and improve malt quality. Nitrogen gas restricted heat formation in some cases more efficiently than circulating air. Nitrogen slowed down germination, but had negligible effect on malt quality. When nitrogen gas was applied during kilning, malt *Fusarium* levels were significantly decreased. The reducing conditions also led to a decrease in malt lipoxigenase activity and an increase in endopeptidase and limit dextrinase activities.

P09 Antifungal potential of yeasts derived from the industrial malting ecosystem

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SUMMARY

Fusarium contamination of barley and malt may cause severe problems in the malting and brewing industry. The antifungal potential of selected yeasts derived from the industrial malting ecosystem was studied with naturally contaminated barley exhibiting gushing potential. Several ascomycetous yeasts showed antagonistic action against field and storage moulds in a plate-screening assay. Furthermore, clear suppression of *Fusarium* growth was observed in malting experiments. Selected strains reduced the hydrophobin production during malting, and thus inhibited beer gushing. Well-characterized microbial cultures can be used as food-grade biocontrol agents and they offer a natural tool for tailoring of malt properties.

P10 Development of proline-specific peptidase activities during malting of cereals

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SUMMARY

Celiac disease is an inflammatory disease which is caused by cereal storage proteins, prolamins. Prolamins are incompletely hydrolysed in the small intestine of celiac patients and some of the formed peptides are toxic to the patients. The present therapy for celiac disease is a strict abandonment of wheat, rye and barley products. However, a new concept of therapy, based on specific enzymes has been proposed. Certain bacterial and fungal enzymes have been found to degrade the toxic peptides. As shown in this study, also malted wheat, barley and oats can all have high proline-specific peptidase activities, such as POP and DPPIV.

P11 Attenuation limit of malt as a function of gelatinisation characteristics of starch

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SUMMARY

Apparent attenuation limit of barley malt extract (AAL) is an important quality characteristic. AAL is described in biochemical terms (Evans et al.). In this paper, the relation of AAL with the gelatinisation characteristics of starch was studied. Starch was isolated from 6 commercial malt samples having similar diastatic power, whereas AAL ranged from 78-84 %. Using both viscometry and differential scanning calorimetry, it was shown that the onset temperature of gelatinisation was negatively correlated with AAL. The amount of pre-gelatinised starch varied and was positively correlated with AAL. It is concluded that the gelatinisation characteristics of starch indeed influence AAL.

P12 A new statistical method to evaluate the malting performance of new barley varieties

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SUMMARY

To describe the reaction of a new barley variety on different malting conditions a single EBC standard micro malting is not enough. The use of statistical software to design scientific trials with the opportunity to calculate a model and forecast the behaviour of a variety on different conditions is an instrument to get maximum information with a manageable number of trials. It allows maltsters to forecast the behaviour of varieties on the change of the three malting parameters vegetation time, water content and vegetation temperature and therefore to optimise malt quality and malting costs according to the individual malting conditions.

P13 Studies on astringent substances in malt

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SUMMARY

It is thought that astringency in beer aftertaste would have a negative effect on total beer quality. Therefore, in order to control beer astringency, we identified components in malt which would be responsible for astringency, and determined their chemical structures to be novel beta glycosides. We developed a malt fractionation technique to control them effectively, based on studies on their behavior in malt processing. We established the malt fractionation system in commercial scale and it has come true to improve the beer quality, using the astringent substances as an index to control of astringency of beer.

HOPS / HOP GENETICS

P14 Comparison among different hop varieties: investigation on their antioxidant activity

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SUMMARY

Several health properties, like the anticarcinogenic effect, are exclusively attributed to some hop secondary metabolites. Only few studies investigated the antioxidant activity of hops comparing different hop cultivars but no works took in consideration varieties grown in the same area under the same experimental conditions. The aim of the present work was to investigate the radical scavenging activity of 15 hop cultivars, harvested in two different crop years (2004 and 2005). A positive correlation was found between the hop antioxidant activity and the alpha acids content, and between the hop antioxidant activity and the xanthohumol levels.

P15 Development of molecular markers linked to powdery mildew resistance genes in hop (*Humulus Lupulus* L.) to support breeding for resistance

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SUMMARY

Breeding for powdery mildew (PM) resistance is first priority at the Hop Research Center Huell. This effort will be supported by developing molecular markers for disease resistance. Therefore wildhops, conferring the best PM resistance, were crossed with susceptible breeding lines. By screening the progenies in a bulked segregant analysis promising AFLP markers were developed. In addition, to identify molecular markers for specific DNA regions involved in pathogen defense, a specific differential display approach was performed. By a comparative cDNA-AFLP screening the gene expression of hops with and without PM attack was analysed. Candidate cDNAs will be transformed into functional markers.

P16 Influence of the new high alpha hop variety Herkules on beer quality

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SUMMARY

Herkules is a new hop variety with an alpha content of 14-16 % and a high cohumulone amount of 32-38 %. The variety was tested versus Merkur, with 12-14 % alpha and a cohumulone content of 17-22 %. The resulting beer was analysed after light exposure as well as fresh, after 3 and 6 months of storage at 28 °C. The different cohumulone content did not have an effect on the beer's quality characteristics. Hence the new hop variety Herkules, with its economic benefits (crop and alpha acid content), can be used in the brewing process without reduction of quality.

P17 Investigations of the odorants comprising hop aroma of beer

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SUMMARY

The odorants comprising hop aromas of beer were investigated. In general, confined hop-derived components can survive in beer; the others evaporate or are metabolized into different compounds during the brewing process. In the current study, strongly hopped and unhopped beers were compared using gas chromatography-olfactometry and sensory evaluation. In total, 27 hop-derived odorants were identified by gas chromatography-olfactometry; these included esters (such as (*S*)-ethyl 2-methylbutanoate and ethyl 4-methylpentanoate), thiols (such as 4-mercapto-4-methylpentan-2-one and 3-mercapto-hexan-1-ol), and aldehydes. The derivations of these components and their contributions to beer hop aromas were investigated.

P18 Detection of two viruses in hop using loop-mediated isothermal amplification

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SUMMARY

Virus free hop is cultivated in the main hop producing countries, and enzyme-linked immunosorbent assay (ELISA) is widely used for checking viruses. Loop-mediated isothermal amplification (LAMP) is a simple, rapid, nucleic acid amplification method. It is characterized by the use of 4 different primers, and detection can be completed in a single step. We developed the detection method of two hop viruses (ApMV and HLV) by using LAMP and investigated sensitivity. LAMP assay was million times sensitive than ELISA, and it seems to be adequate for first screening as bulk assay.

P19 Identification of novel unique flavor compounds derived from Nelson Sauvin hop and development of a new product using this hop

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SUMMARY

Nelson Sauvin (NS) is a unique hop variety that gives a specific flavor (exotic fruits-like, wine-like) to finished beers. We have attempted to identify the specific flavor compounds derived from NS. Firstly, 2-methylbutyl isobutyrate has been identified in the beers used with NS. This compound has a green apple-like flavor. We next focused on certain volatile thiols that are well known to contribute to wine flavors, especially Sauvignon Blanc. We identified some volatile thiols having a grapefruits-like odor, similar to the one of Sauvignon Blanc. The volatile thiols would explain the specific odor of beers produced with NS.

P20 The influence of hop storage condition on the quality of aroma and bitterness in beer

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SUMMARY

The storage of hops results in increased levels of alpha and beta acids oxidation products such as humulinic acid and hulupone. In this research, we have focused on odor components and bitter substances that tend to be present in greater amounts in beer brewed with stored hops. We found that beer brewed with stored hops contains substances which increase depending on storage heat and time, quality of aroma and bitterness of beer was good when these substances are in the some extent of the range. This new index can be an effective tool for brewers investigating and assessing the mild bitterness.

WORT / WORT PRODUCTION

P21 Creation and vaporescence of dimethylsulfide in mashing procedures - prediction of the content in copper-up-wort

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SUMMARY

Vaporescence of aromatics is a constant process during the whole production of beer. To improve the control over the whole procedure and to raise by that way the quality of wort it is important to understand their fundamental kinetics. As an example the creation and vaporescence of the most important flavour dimethylsulfide (DMS) during mashing is calculated and researched. Therefore the vapour-liquid-equilibrium and the mass transfer have to be determined. The presented poster defines and describes the necessary theoretical basics and experimental methods to describe the content of DMS in wort.

P22 Study of the impact of beta-glucans and arabinoxylans on wort viscosity by High Performance Steric Exclusion Chromatography

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SUMMARY

Beta-glucans and arabinoxylans are major constituents of both aleurone and starchy endosperm cell walls. Their impact on brewing process and beer quality has been demonstrated several times. In this work, the influence of their structure, concentration and viscosity were studied by HPSEC to develop a new technique to prevent filtration difficulties. Thanks to lichenase and xylanase application on barley and malt extracts, specific signals for β -glucans and arabinoxylans were identified. After malting, the intensities of peaks attributed to β -glucans dramatically decreased whereas those of arabinoxylans remained constant. Differences among varieties were shown and correlated with mash filtration duration.

P23 Mash filtration: pre-compression with water as an efficiency improvement method for sparging thin layer filter cakes

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SUMMARY

The use of high gravity brewing is becoming a general practice, so reducing sparging water is an objective for brewers. Modern filters use four times more water than the theoretical optimum for sparging. Homogeneity on cake during pre-compression when using air or water for inflating the membranes has been examined due to distinct differential pressure over the cakes. Using water instead of air for inflating the membranes filter cakes shows a more homogenous thickness and the sparging efficiency is improved; for this reason water consumption per kg of malt can be reduced from 2.6 lt to 1.6 lt.

P24 A new wort boiling system based on rectification

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SUMMARY

Based on the basics of evaporation a new and retrofit wort boiling system was constructed. This system is based on a rectification. By this way, unwanted flavours are strongly enriched in the evaporating vapour. Thus, the discharged steam has a concentration of unwanted flavours that is much higher, in comparison to a former used boiling system. Depending on the previous boiling system, up to 50 % of the over all evaporation can be reduced although the aroma profile of the resulting wort stays equal. This system can be retrofit in nearly every existing wort kettle. The energy savings are enormous.

P25 Apparatus and procedure to reduce the recreation of off-flavours during the whirlpool rest

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SUMMARY

In times of shortened boiling processes, the conversion of precursors of unwanted flavours is often insufficient. Thus, off-flavours are recreated furthermore during the whirlpool rest and cannot be reduced without an additional evaporation, even to the present day. Test trials have been carried out on a bench-scale unit and with suitable mountings the air above the wort was permanently exhausted during the whirlpool rest. As a result it can obviously be shown, that a significant difference in measured concentrations exists e.g. for furfural and dimethyl sulphide (DMS).

P26 β -damascenone, a suitable heat load indicator during wort boiling?

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SUMMARY

β -damascenone is a well-known potent flavour compound that appears during beer aging. However, the formation of β -damascenone is not an exclusive beer aging phenomenon, as it appears during wort boiling. To appreciate the evolution of β -damascenone, wort boiling experiments were performed. The results showed an increased concentration of β -damascenone, when a higher thermal load was applied to the wort. Its formation was also enhanced by a low pH. Due to its low volatility and limited reactivity comparing to e.g. furfural, β -damascenone could be a suitable heat load indicator for wort.

P27 Improving brewhouse performance by chain management

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SUMMARY

In the supply chain barley-malt-wort within Royal Grolsch every step in the chain from barley growing up to malt deliveries, is done without blending. The grain stays as one entity through the chain. On a weekly basis the single malts are used in monobrews in order to establish the quality and yield potential. The results are collected and put in a database. The trends derived from the data makes it possible to adjust and direct the quality of the wort. Also decisions are made which varieties are used and which single malthouse suites best for converting a certain barley variety into malt.

YEAST / YEAST GENETICS

P28 New evaluation method of yeast vitality combining the short intracellular pH measurement (S-ICP) with flowcytometry

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SUMMARY

The measurement of the intracellular pH using the S-ICP-method has proofed to be a sensitive indicator of the physiological condition of yeast. However, with conventional S-ICP methods only a mean value and not the distribution of yeast vitality in a population is determined. The aim of this research was to modify the S-ICP method for use with a flowcytometer and compare the results with the “classic” S-ICP method. Both methods show a good correlation for various samples. The advantage of the S-ICP method using a flowcytometer lies in the additional information about the vitality of the whole yeast population.

P29 Age-related induction of ‘petites’ in brewing yeast strains with differential pro-oxidant sensitivities

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SUMMARY

Petite frequency within a batch of brewing yeast typically increases with repitching. It was hypothesised that this form of mutation may be related to cellular ageing and the cumulative damage caused by oxidative stress due to repeated exposure to aerobic conditions. Both exposure to oxidative stress and chronological ageing resulted in the induction of petites in ale and lager yeast strains. Strains sensitive to oxidative stress were also sensitive to cellular ageing. The results indicate that ageing may contribute to mitochondrial DNA damage and strains with less sensitivity to oxidative stress are less likely to generate petites during serial repitching.

P30 Managing amino acid metabolism - managing oxidative stress

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SUMMARY

This study has provided insights into the regulation of known stress genes by transcription factors, which ultimately will be of value in understanding yeast behaviour. But it also has provided practical insights for beer makers. Brewers strive to suppress oxidation of wort and oxidation events during fermentation. Some believe that accumulative oxidation diminishes the quality of the final beer and shortens the life span of beer on the shelf. This study on amino acid synthesis shows how yeast try to avoid debilitating oxidative effects. The lesson herein is to ensure that the yeast and the brewer are working towards the same common goal.

P31 A new assay for the screening of brewing yeasts in their ability to excrete hydrogen sulfide

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SUMMARY

Hydrogen sulphide plays a key role in beer quality: 1) consumers can easily detect its rotten-egg typical aroma 2) it can easily bind to allylic alcohols to generate odorant polyfunctional thiols. In order to help brewers to avoid such unpleasant flavours in fresh beer, a new assay was optimized to investigate a large series of *S. cerevisiae*, *S. pastorianus* and *S. bayanus* strains. This quantitative method revealed to be very efficient to compare a large series of yeast strains. Strong differences emerged between bakery, top-fermented and bottom-fermented yeasts. Surprisingly, a relationship was evidenced with the glutathione intracellular concentration.

P32 Yeast physiology a key to optimize fermentation process

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SUMMARY

The PDH-bypass is the only possibility for yeast to generate cytosolic Acetyl-CoA for sterol and lipid biosynthesis. The measurement under brewing conditions was investigated for the first time and a deeper insight into yeast physiology was achieved. Due to the fact that enzyme activities increased during fermentation, tests were initiated with aeration breaks during propagation to force physiological conditions to raise a yeast with high fermentation power. The propagation tests showed a stimulation of the enzymes within aeration breaks. Such treated yeast showed a higher extract decrease and fermentation was up to 20 h faster. The gained knowledge of yeast physiology offers new possibilities for fermentation management.

P33 Application of DNA microarray analysis for identification of lager yeast strains and detection of mutation in lager yeast

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SUMMARY

We developed DNA microarray based on all genes and intergenic sequences of lager brewing yeast, which was expected to detect slight genomic differences among various yeast strains. Comparative genomic hybridization using this microarray revealed that genomic differences among lager strains occurred not only in intra-/inter- genic sequences but also in numbers of chromosomes which could remarkably influence their fermentation performances. Furthermore, it was found that this type of difference was possibly promoted in lager yeast by oxygen stress. This microarray could discriminate lager strains and detect mutations which would be important to control beer quality.

P34 Gene expression analysis of lager yeast under different oxygenation conditions using newly developed DNA microarray

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SUMMARY

It is known that oxygenation condition has a strong effect on lager yeast metabolism during beer fermentation. However, its mechanism has not been fully understood. Therefore, we analyzed yeast gene expression under different oxygenation conditions using the newly developed microarray which contains all genes of lager yeast. Lager yeast has two divergent *S. cerevisiae* (Sc) and *non-S. cerevisiae* (non-Sc) type genes, and it was revealed that low sulfite productions under high oxygenation condition could be attributed to decreased expressions of *non-Sc* type genes in sulfite production pathway. This microarray could obtain essential information of lager yeast metabolism concerning beer quality.

P35 Interspecific hybrids between *S. cerevisiae* and *S. bayanus* to be used as a genetic model to study the organisation of the lager yeast genome

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SUMMARY

We constructed two interspecific hybrids by spore conjugation to mimic the complex genetic constitution of lager brewing strains. We employed a sporulating *S. bayanus* parental strain bearing high similarity to the *S. bayanus*-type genome of lager yeasts. We tested some portions of the genome of the two *in vitro* hybrids and of common lager strains. While the hybrids showed the addition of both parental strains genome, lager strains lacked some portions of the putative parental genomes. These hybrids will be useful tools to study the dynamic of lager yeast genome and to set the basis for genetic improvement programmes.

P36 A new source to obtain brewing yeast strains adapted to very high gravity brewing (VHGB): isolation and characterisation of 2-deoxy-D-glucose resistant clones with improved fermentation capacity

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SUMMARY

VHGB usually leads to poor fermentation performances. Clones resistant to 2-deoxy-D-glucose, with capacity of metabolising maltose in the presence of glucose, may be a solution. A new method to isolate and characterise 2-deoxy-D-glucose clones adapted to VHGB (25 °P) has been developed. Those clones with vigorous growth in liquid and plate YM-rich cultures and high performance in mini-VHGB-fermentations were tested for VHGB suitability in 2-liter EBC tubes. Significantly improved fermentation rates, without changes in beer flavour profile, yeast viability and genetic stability, confirm that 2-deoxy-D-glucose resistant clones are a convenient source to obtain yeast strains adapted to VHGB conditions.

P37 Lager yeasts transport maltose at low temperatures more efficiently than ale yeasts because they lack *Agt1* transporters

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SUMMARY

Lager yeasts originate from low temperature fermentations. Ale yeasts evolved at higher temperatures. Both contain *MALx1* and *AGT1* maltose transporter genes but in all 8 tested lager strains, *AGT1* was non-functional. Ale and lager yeasts have similar maltose transport activity at 20 °C, but lager yeasts have 6-fold higher activity at 0 °C. Maltose transport by a glucose-grown lager transformant containing an ale yeast *AGT1* gene driven by a *PGKI* promoter showed still higher temperature-dependence than ale yeasts. Evidently, the properties of *Agt1* transporters rather than differences between membranes of ale and lager yeasts cause the differences in temperature-dependence.

FERMENTATION

P38 The impact of process parameters on flavor profile of alcohol-free beer from a single-stage continuous gas-lift reactor with immobilized yeast

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SUMMARY

Among existing methods of alcohol-free beer production, continuous fermentation systems can outperform the rival technologies but it is essential that they produce a competitive final product. The objective of this study was to optimize the process parameters (temperature, residence time, aeration) in regard to product composition. It is shown that fine tuning of the oxygen supply, based on real oxygen transfer data, is the most powerful tool to adjust the higher alcohols to esters ratio. The average aldehyde reduction efficiency seemed to be independent on aeration and the concentration of VDK's was during the whole experiment below the taste threshold.

P39 Prolonged flavour stability by production of beer with low residual FAN using active dry yeast

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SUMMARY

The assimilability of FAN using active dry yeast is not investigated nowadays. Also the hopping technology and boiling intensity in relation to the assimilability of FAN is studied. Low FAN contents in pitching wort do not influence yeast performance and attenuation. Higher C/N ratios result in very low residual FAN levels, even for 20 °P. High heat loads decrease the assimilability of FAN during fermentation. High Tech Hopping compared to conventional hopping, leads to lower residual FAN levels in beer. The analytical data and sensory evaluations demonstrate the negative relation between high residual FAN levels in beer and the flavour stability.

P40 Application of system biology on brewer's yeast - future diagnostics tools for the high gravity brewing industry

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SUMMARY

We characterised in series of batch cultivations, the lager beer strain Weihenstephan 34/70 at average gravity at 14 °Plato and at high gravity - 21 °Plato and 24 °Plato fermentations. Distinct differences were observed in the individual amino acids uptake, flavour and aroma profile of the final beer and the intracellular metabolites between the 14° and 24 °Plato fermentations. The detailed physiological characterisation of the Weihenstephan 34/70 strain and the application of different “omics” techniques, enable us to obtain a further insight into the stress response of the yeast cells in high gravity beer fermentations and provides more diagnostic tools for the beer industry.

P41 Effects of the heat stable beta-amylase gene on fermentability of malts with low versus high diastatic power

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SUMMARY

Fermentability of wort can be significantly improved when malts are made from barley with a heat stable gene for beta-amylase. The effect of the heat stable gene in barley with potential for higher levels of diastatic power was investigated with two doubled haploid populations, each with one parent having the heat stable gene. The heat stable beta-amylase gene was not essential for high apparent attenuation limit (AAL) or ethanol production provided there was sufficient diastatic power. However, AAL and ethanol production were better predicted by specific starch-degrading enzymes, alpha-amylase and limit dextrinase, than by diastatic power.

P42 Influence of sugar composition and yeast strains on sulfur metabolism

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SUMMARY

The yeast strain that produces high level of sulphur dioxide normally produces high level of hydrogen sulfide. However the production ratio of the two compounds depends on the yeast strains and the fermentation conditions. Sulphur dioxide and hydrogen sulfide production was compared using the 8 yeast strains and various worts. The higher the glucose ratio was, the higher sulphur dioxide and hydrogen sulfide was produced. With maltose, yeast produced less sulphur dioxide and hydrogen sulfide than with glucose. If more sulphur dioxide and less hydrogen sulfide are required, appropriate yeast strains should be used in each wort with various constituents.

P43 Towards a consistent lag phase in fermenter: predictive biomarkers of brewery yeast performance

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SUMMARY

Consistency of fermentation duration is a key issue for the brewing industry. Lag phase, the time required to progress from yeast pitching to initial bud emergence, can contribute considerable variation in total fermenter residence time. Gene expression profiles and cell morphological changes indicative of lag phase progression have been identified using real-time PCR and fluorescence microscopy, respectively in a laboratory haploid and a lager brewing yeast strain. It is suggested that these biomarkers will permit monitoring of lag phase progression during full scale brewery fermentations and will provide predictive tools for more effective control of yeast performance immediately after pitching.

P44 Expression of genes for glucose, maltose and maltotriose metabolism and for membrane lipid synthesis through wort fermentations: a TRAC study

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SUMMARY

A rapid, accurate transcription profiling method (TRAC) was used to follow at frequent intervals expression of >70 *S.cerevisiae* and *S.bayanus* genes through tall tube wort fermentations by industrially cropped lager yeast. Genes for malto(trio)se metabolism showed strong co-ordinate increases before glucose began to be used and declined while maltose concentrations were still high. Expression of genes for ergosterol synthesis (needed for correct membrane function) peaked in the first few hours and again late in fermentation when oxygen was absent. Evidently the physiology of lager yeast fermenting wort diverges from that of laboratory strains in laboratory media.

FILTRATION / STABILISATION

P45 Characterisation and efficiency of new regenerable polymeric filter aids for beer filtration

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SUMMARY

Since decades, kieselguhr has been the most common technique for beer filtration. However, despite satisfying results, kieselguhr seems to present drawbacks such as health hazards and increasing costs for disposal. Beer filtration using a regenerable synthetic filter aid seems to be an alternative to kieselguhr. Oxidised High Density Polyethylene (HDPEox) has been characterised (morphology, size distribution, etc.) and tested on a pilot candle filter. Results showed an appreciable clarifying ability (average of 1 EBC) using HDPEox. Regeneration of the polymer has been also especially examined and seems to be efficient without any alterations of its properties.

P46 Innovative filtration of beer with a single pre-coat free of kieselguhr

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SUMMARY

This innovative application for beer filtration enables to process a sole pre-coat that ensures a role of support for the whole coat after only 35 minutes of closed circuit, enables a good turbidity and microbiology, with a filterability allowing optimization from both the qualitative (EBC 25° < 0,15, EBC 90° < 0,50) and economical (cost/hl) point of view. The adjuvant is mainly composed of cellulose to improve adsorption of small particules, cotton as a great resistance to Δpressure and perlite as a support and homogeneity of the panel or the candles. The reduction of kieselguhr could be reduced up to 15 %.

BEER QUALITY

P47 Suppressing foam in process ... naturally

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SUMMARY

The control of foaming, both during wort boiling and during fermentation has several advantages, including increased capacity of kettles and fermenters, and better retention of foam-positives for the foam stability of final beer. Here, we demonstrate the use of natural antifoam preparations, based on lipid fractions from hops. The lab-scale trials indicated the dosing levels of for foam suppression during both operations and for lager and ale worts. These observations were confirmed on a pilot scale, and neither had any significant impact on final beer quality. These findings show that these hop based antifoam products offer a natural alternative to those based on silicones.

P48 Product quality, product safety and product integrity through consistent process monitoring

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SUMMARY

To evaluate the potential for increasing production safety and efficiency, continuous inline measuring equipment has been installed throughout the brewery, from brewhouse to filling plant and waste water monitoring. As a result, product quality and production yield are improved in all production steps where inline measurements have been installed. Process stability can be kept within narrow limits. Unacceptable deviations are immediately detected, and countermeasures can be taken. Complete documentation of the beer production ensures that product standards are outstandingly high.

P49 Evolution of chemical and sensory bitterness during ageing of top fermented and bottle conditioned beer

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SUMMARY

The evolution of the sensory bitterness during ageing and correlation with the iso-alpha-acids and antioxidant compounds content has been evaluated during 12 months of ageing. A decrease of the iso-alpha-acid amount in the beer occurs. An effect of antioxidants on the IAA degradation during fermentation and conditioning have been pointed out. The IBU were correlated to IAA during ageing with no significant changes in the slope of the linear regression curves. The decrease of bitterness perception is maybe due to sensory masking effect of the IAA, induced by substances produced in ageing and to an increase of the sweet taste.

P50 Improving beer drinkability using multivariate analysis

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SUMMARY

Experience shows that improvements in fresh flavour and flavour stability are often the result of several minor process adjustments. Due to the large number of variables involved in producing beer it can be difficult to demonstrate the influence of such individual adjustments in full-scale production, and it can be difficult to conclude what are the most relevant factors that cause variation in the beer quality. A powerful method to overcome this problem is to use Multivariate Statistical Analysis (MVA) to analyse data with the purpose of taking qualified decisions regarding modifications in process and raw material specifications. In the method described, 10 normal beers were produced and tasted, and sensory results correlated to process and analytical data using MVA. Based on these results the five strongest correlating parameters were adjusted and a set of five trial beers and five control beers were produced. The sensory, process and analytical data of the samples were evaluated by MVA and in the third step the most effective adjustments, or combinations thereof, were implemented in production. The sensory analyses were based on evaluations carried out by both the brewery panel and the Danbrew expert panel. Analyses of special staling chemicals were used to back up the findings of the sensory analyses. Our results indicate an improvement in fresh beer flavour of and a reduction in T2N intensity in forced aged beer samples. Furthermore several staling descriptors were reduced in concentration. MVA should also be used to analyse fluctuations in daily production, where numerous data are collected but not properly analysed. It is a very effective tool due to the limited number of trials required and the utilisation of available data. The outcome of MVA projects will typically be a stronger position in the market due to the increased drinkability and improved flavour stability. Additionally, it is considered advantageous to improve the knowledge about own brewing process. We propose that the method described is used as an active tool to support marketing of a quality premium brand. Danbrew has conducted 8 such projects over the past 5 years.

P51 Polyfunctional thiols in different kinds of beer: their responsibility in the onion-like off-flavour

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SUMMARY

Polyfunctional thiols are known to be strongly involved in the flavour of fresh lager beer. Nine different fresh beers - lager, white and top-fermented - have been studied. More than ten polyfunctional thiols were found in most of the samples. Among them, two thiols were characterized by a strong onion-like off-flavour (2-mercapto-3-methylbutanol and 3-mercapto-3-methylbutanol). They revealed to be derived from the radical and electrophilic additions of H₂S on 3-methyl-2-buten-1-ol. The hop varieties and the ability of the yeast strain to produce hydrogen sulphide emerged as the main parameters to control.

P52 Fate of polyfunctional thiols through beer ageing

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SUMMARY

Polyfunctional thiols have been recently identified as key-flavours of a fresh beer. Their evolution through ageing must therefore be of prime concern for the brewers. Different kinds of lager, wheat and top-fermented beers have been studied for six months at 20 °C. One sample was also investigated after one year at 4 °C. Thiols revealed very unstable in most beers, already after one month of storage. Thiols are very sensitive compounds that can react with other components like quinones. This study explores different reaction pathways which explain how the polyfunctional thiol profile is modified.

P53 Sensory characterization of hexahydro-iso-alpha acids in comparison to other reduced hop bitter acids

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SUMMARY

Hexahydro-iso-alpha-acids have foam enhancing properties and are also suitable for so called “light stable” applications. But only little is known about the sensory characteristics of hexahydro-iso-alpha-acids. The determination of taste thresholds of hexahydro-iso-alpha acids and a mixture of hexa- and tetra-hydro-iso-alpha-acids in different media showed that the thresholds are matrix depending. A profile mapping of different products revealed different bitterness properties for pure hexa-hydro-iso-alpha-acids and the mixture of tetra- and hexa-hydro-iso-alpha-acids. Since hexa-hydro-iso alpha acids also affect foam as tetra does they could be used as a substitute for tetra or as an addition to e.g. rho-iso-alpha-acids due to its different bitterness properties.

P54 Myths and truths in sensory analysis

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SUMMARY

Sensory analysis is now well established as a tool to better understand consumer perception in both food and non-food industries. Despite this, in the public eye this technique remains little known and is often oversimplified or quoted incorrectly in scientific articles or presentations when presented. The aim of this interactive poster is to provide a scientific challenge to some of the “myths” that have been established within the sensorial analysis field. The poster, through its interactive element, will provide an opportunity to re-examine the sensory map of the tongue.

P55 Polyphenol and colour stability through beer ageing

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SUMMARY

Beer quality is known to deteriorate greatly with time. In the last decade, many papers have underlined the key role played by different off-flavours (*trans*-2-nonenal). However, data are scarce concerning beer polyphenols although changes of their structures through storage induce important alterations. To better understand which flavanoids are responsible of the colour of aged samples, they were analysed by NP-LC-ESI(-)-MS/MS from a LH20 acetone extract. Whereas colour increases, the level of small flavanoids parallelly decreases, leading to the formation of yellow/brown adducts. ESI (-)-MS/MS analysis of aged model media allowed us to identify the structure of the most interesting compounds.

P56 Practical membrane filtration for beer clarification: its influence on taste and colloidal stability

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SUMMARY

The aim of this research was to identify the influence of membrane filtration on taste and colloidal stability of beer. We set a Kieselguhr against a Cross-Flow membrane filtration installation and monitored the entire filtration process followed by a storage trial. After various comparative chemical and physical tests it was determined that the membrane filtrated beer had a lower iron and oxygen intake and a much lower ESR Signal intensity. It also differs by a somewhat higher endogenous anti-oxidative potential (EAP-value) and taste panels showed a slight preference for the beer that was filtrated in the membrane filtration installation.

P57 Use of a 1,3-diamine scavenger resin to reduce the concentration of staling markers in beer

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SUMMARY

α -dicarbonyls have previously been shown to be important precursors of ageing components in beer. Using a 1,3-diamine scavenger resin α -dicarbonyls of the 3-deoxysone type, 3-deoxy-2-hexosulose (3-DH) and 3-deoxy-2-pentosulose (3-DP), were selectively removed from fresh beer without affecting general beer attributes except for a reduction in beer colour. During subsequent ageing of resin treated beer the accumulation of staling markers HMF and furfural was reduced compared with a non-treated beer. This demonstrates the role of 3-DH and 3-DP as precursors for the furanic aldehydes and offers new opportunities to improve strategies for maintaining the fresh beer flavour during storage.

P58 The impact of current brewing processes in the long term flavour stability of beers

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SUMMARY

The impact of raw materials and brewing process conditions on the long term flavour stability of beers was investigated. Various breweries were benchmarked in malt source and quality, wort production and fermentation processes. Worts/beers were analyzed for free radicals using ESR, antioxidant, hydrogen peroxide, aldehydes, thiols and various other parameters. The source and quality of malt, mashing conditions and wort oxygenation process can have a significant impact on flavour stability influencing the level of aldehydes and ROS present in the fermented beer. Beer flavour stability can vary between breweries due to variability in process equipment, brewing practices and raw materials.

P59 Influence of malt quality on the generation of odour-active Strecker aldehydes during beer aging

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SUMMARY

Present analytical and sensory studies have shown that the main odour-active components of the aged flavour in beer are caused by Strecker degradation. To study the influence of malt quality on Strecker aldehyde generation during beer storage, selected malts with various soluble nitrogen and protein contents were used for brewing trials in 20 hl scale. In fresh bottled beers the amounts of Strecker aldehydes were not influenced by the malts used. In stored bottled beers the use of malt with higher Kolbach index and higher level of soluble nitrogen resulted in a significantly increased formation of Strecker aldehydes.

P60 An integrated analytical–sensorial methodology for adequate evaluation of the flavour stability of Pilsner beer

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SUMMARY

Adequate evaluation of beer flavour stability requires an integrated methodology. Flavour deterioration is caused by many transformations during ageing. The flavour changes of six Belgian lager beers are studied in order to select relevant analytical and sensory markers for beer ageing. For efficient evaluation of flavour stability it is necessary to accelerate the ageing process. Beer ageing at 30 °C is preferred to 40 °C, because it is more comparable to spontaneous ageing. The proposed integrated methodology comprises profiling of aldehydes, bitter acids and aroma components, and determination of flavanoid content, reducing power and beer colour, in combination with the overall-ageing-score.

P61 Protein-lipid interactions and beer flavour stability

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SUMMARY

Proteins and lipids are known to interact with each other and form complexes in food matrices. In the present work we used a well-known and characterised protein BSA (bovine serum albumin) as a model protein to study protein-lipid interactions in brewing. The results demonstrate that added protein had a well defined effect on the lipid distribution between insoluble material and the liquid phase. In addition, an ability of this protein to protect lipids from harmful reactions was noticed. Furthermore, BSA seemed to be able to react with carbonyl compounds. This study shows that proteins can have diverse effects on lipid reactions during brewing.

P62 Impact of hop polyphenols and antioxidant properties of wort on formation of carbonyl compounds during boiling process and storage of beer

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SUMMARY

Clear evidence of impact of hop polyphenols and antioxidant properties of wort on formation of carbonyl compounds during boiling process as well as during storage of beer was discovered. Data collected by both methods for determination of antioxidant properties (ABTS and DPPH) were completely compared (correlation coefficient = 0.8988). Brews prepared with reduced content of hop polyphenols showed higher increment of carbonyl compounds content during wort boiling and beer storage in comparison with brews prepared with higher content of hop polyphenols.

P63 Mechanisms for development of Strecker aldehydes during beer aging

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SUMMARY

Strecker aldehydes, such as methional and phenylacetaldehyde, are considered to be important constituents of the aged beer flavor. In this study, we found that 85 % of the Strecker aldehydes, which increased during beer aging, originated from Strecker degradation in the wort production process, and the other 15 % originated from Strecker degradation in bottled beer itself. This means that the repression of Strecker degradation in the wort production and the reduction of Strecker aldehydes that transfer into bottled beer are the most effective ways to reduce the aldehydes of beer, which can lead to improvement of flavor stability of beer.

P64 Low molecular weight proteins in beer and beer foam

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SUMMARY

The barley-derived protein Z (43 kDa) is one of the main protein components in beer. In contrast the lipid transfer protein 1 (LTP1, 10 kDa), hordein and glutein fragments (17 kDa) as well as LTP2 (7 kDa) belong to the low molecular weight fraction. Protein Z and LTP1 have an important role in foam formation and for foam stability. However, the involvement of other protein components in foam formation/stability cannot be clearly excluded. Proteins of very low molecular weight (2,5-5 kDa) were separated and detected in beer and beer foam. In addition the 2,5 kDa protein seems to be associated with protein Z.

P65 Rapid prediction of beer colloidal stability

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SUMMARY

Colloidal stability of beer is mostly predicted by simple but time-consuming forcing tests. In order to establish faster alternatives, more than 90 market samples were analysed by a variety of methods shortly after packaging and then stored up to one year at 20 °C or 30 °C. Data obtained for both highly and rather poorly stabilised samples show that haze after 4-6 months correlates well ($R^2 \geq 0.90$) with results from simple nephelometric analyses, ready in less than one hour. Analysis of samples of poor stability can elucidate whether this is caused by too high levels of haze-active proteins, polyphenols, or both.

P66 A measurement system for haze stability of turbid beers

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SUMMARY

An intensive and stable haze is an important quality characteristic for Belgian and German style white (or wheat) beers. In a test series with pilot scale and commercial white beers the changes in particle size distribution were observed over a period of eight weeks and longer. The values of the particle fraction < 1 µm showed a low decrease, so this fraction seems to be stable in suspension and the relevant particle class for haze stability. The quantification of haze by particle size distribution presents a needful tool for the detection of permanent haze and to forecast haze stability.

ANALYSES

P67 Pressurized Fluid Extraction in connection with CoulArray detection - new progressive alternative of polyphenol extraction and detection in malt and hops

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SUMMARY

Modern Pressurized Fluid Extraction (PFE) technique coupled with HPLC and high sensitivity CoulArray detection was used for analysing of some polyphenols in malt and hops. Qualitative and quantitative dependence of extracted polyphenols on extraction temperature was found under optimized extraction conditions of PSE technique. Recoveries within temperature interval 40-60 °C were constant. Outside of this interval concentrations of some polyphenols depend on the temperature significantly. Obtained results were compared with results obtained by currently used warm water extraction methods (e.g. congress mashing). This PSE method together with HPLC and high sensitivity CoulArray detector could be a basis for standard analytical methods which could be independent on any enzymatic activities.

P68 Pressurized Fluid Extraction - new progressive alternative of extraction of bitter acids from hops and hop products

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SUMMARY

Currently used EBC method 7.7 is time-consuming and laborious extraction method. Our aim was to propose a new extraction method based on Pressurized Fluid Extraction (PFE). Compared to conventional extractions, PFE offers a number of important benefits. PFE on OnePSE automated extractor was used for extraction of α - and β -acids from hops and hop products. The parameters influencing extraction efficiency were studied as well as the influence of the sample preparation method. The quantitative determination of α - and β -acids in extracts was accomplished using an HPLC equipped with diode array detector. The experimental results were compared with those obtained by standard EBC method 7.7. PFE method presents a promising alternative to EBC method 7.7.

P69 Better knowledge of flavanoids in fresh lager beers: comparison of extraction methods and use of the thiolysis hyphenated to RP-HPLC-ESI (-)-MS/MS

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SUMMARY

Control of polyphenols in beer is of prime importance for brewers. Unfortunately, general assays are too often used to quantify them, without taking into account that each molecule can impart different properties to beer. For the first time, thiolysis assay was applied on different beer extracts. The small oligomers were recovered in LH20 acetone beer extracts. Flavanoids were further degraded with benzylthioether before analysis by RP-LC-ESI(-)-MS/MS. Most beer dimers revealed to be procyanidins B3 while trimers are prodelfinidins. Gallo catechin were mainly issued from malt. Surprisingly, no galloepicatechin were found in the final beer, although detected in hop.

P70 Prediction model to forecast the lautering properties of commercial malts

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SUMMARY

Increased mechanisation and automation of the whole brewing process and the trend towards ever larger production charges has considerably increased the demands on the quality of the raw materials and especially their trouble-free processability. Around 150 commercial malts of varied origins were processed in brewing trials on an industrial scale and their lautering properties characterised. A prediction model is presented which, based on a multivariate statistical evaluation, uses the results from a modified conventional malt analysis to forecast the processing risks during industrial lautering. The regression model, so developed, open up unknown possibilities for the risk evaluation of malts.

P71 New strategies for protein and proteolysis research in barley to beer chain

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SUMMARY

Modern protein research offers potential new methods to be applied in malting and brewing process research, development and control beside the traditional protein analyses. In this study we detected differences induced by variety and protein content in barley, malt and wort by 2D electrophoresis, as well as peptide and amino acid analysis based on capillary electrophoresis (CE) and high-performance liquid chromatography (HPLC), respectively. Moreover, the inhibition of the main groups of proteolytic enzymes resulted in different wort peptide spectra. The modern protein techniques complemented the picture of protein reactions during malting and brewing.

P72 The meaning of water soluble vitamins B1 and B2 in the brewing process measured by HPLC

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SUMMARY

The often very complicated HPLC methods to determinate vitamins in cereals, wort and beer are replaced by a medical application for determination of B-vitamins, which is easy to apply in brewery sector. Vitamin B1 (thiamine) is water soluble and heat sensible. Vitamin B2 (riboflavin) is water soluble, photosensitive, but heat stable. Thus they are suitable as analytical parameters in the brewing process. A screening of the vitamin content of different cereals shows great differences in the vitamin content. The study shows that vitamin B1 could be pointed out as an indicator for thermal load during the wort boiling process.

P73 Benefits of negative chemical ionisation mass spectrometry for quantification of trace amounts of chloroanisoles in beer

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SUMMARY

Musty off-flavours like chloroanisoles have hardly been considered in beer until now. Chloroanisoles impart a mouldy odour to bottled beverages, referred to as cork taint. Their sensory thresholds in beer range from pg/l to ng/l, which are levels well beyond the sensitivity of routine analytical equipment. A novel method for simultaneous identification and quantification of chloroanisoles in beer, cork, cardboard and glass, has been developed. Combination of headspace solid phase microextraction, capillary gas chromatography and negative chemical ionisation mass spectrometry enables consistent sampling without sample pre-treatment, and highly selective, fast, and accurate determination of chloroanisoles at extremely low levels (pg/l).

P74 Determination by HPLC with UV detection of diacetyl and 2,3-pentanedione during beer fermentation after separation in a pervaporation module

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SUMMARY

An automated flow manifold was developed for sampling and determination of vicinal diketones in beer. The manifold contains an on-line extraction module and a conversion unit, for the on-line conversion of the precursors. The beer sample (must or beer) is passed continuously through the precursor conversion unit and through the lower chamber of the extraction module. After a time of accumulation the upper solution is analysed in a HPLC system. The results obtained were similar to those obtained with the usual GC-ECD methodology. The method proves to be advantageous in terms of simplicity, reproducibility, time analysis and automation.

P75 Characterisation of Z- and E-4,5-epoxy-2E-decenals by Isotope Dilution Assays

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SUMMARY

Z- and E-4,5-epoxy-2E-decenals are strongly reactive and off-flavour compounds resulting from the peroxidation of fatty acids. A novel and simple chemical synthesis of deuterium and C-13 labelled Z- and E-4,5-epoxy-2E-decenals was established. Deuterated epoxydecenals were used in isotope dilution assays for quantification and C-13 labelling was used to characterise reaction products of C-13 epoxydecenals with compounds in beer or wort by C-13 NMR. The flavour of Z-epoxy-2E-decenal was confirmed to be metallic, whilst the trans-epoxide was classified as malt-like. Epoxydecenals were analysed successfully in malt, wort, beer and cereals. The beer flavour is of high relevance for the practical brewer and until now low attention was given to the epoxydecenals.

NUTRITION & HEALTH

P76 Resveratrol analogues in hop, malt and adjuncts

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SUMMARY

Resveratrol, already identified in wine and other food matrixes, seems to be linked to anti-carcinogenic, anti-viral, anti-oxidant, anti-inflammatory and estrogenic activities. Behind resveratrol, its analogues also exhibit similar activities. In hop, *trans*- and *cis*-piceid have already been identified. The aim of the present work was to investigate resveratrol analogues in hop, malt and adjuncts. Hop and red sorghum appeared as the most interesting raw materials in terms of polyphenols concentration and profile. An analogue of pterostilbene at concentration up to 1 ppm revealed especially particularly interesting for increasing beer health potential.

P77 Influence of brewing raw materials and brewing technology on phytoestrogens content in beer

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SUMMARY

Phytoestrogens in different malting barley and hop varieties was investigated. An effect of brewing technology on phytoestrogens content in beer was examined. Significant differences among barley as well as hop varieties were detected. Mashing procedure, hopping technology, fermentation and beer colloidal stabilization have significant impact on phytoestrogens content in beer. There were developed manufacturing technology of low-alcohol pale table beer rich in phytoestrogens based on brewing raw materials selection and optimization of beer brewing process. Results of clinical-laboratory prospective medicinal study proved that this beer evidently reduced acute climacteric symptoms of women.

P78 The inhibitory effect of hop water extract on influenza virus infection

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SUMMARY

Influenza epidemics cause severe respiratory illness and kill many people worldwide every year. The inhibitory effect of hop water extract (HWE) on influenza virus infection was examined using the hemagglutination inhibition (HI) test, the inhibition of the virus growth in MDCK cells (in vitro) and the morbidity and mortality of mice after nasal infection of the virus (in vivo). As a result, HWE significantly inhibited influenza virus infection by its binding to the surface of the virus and inhibiting the virus adhesion to epithelial cells in the respiratory tract. HWE is a promising material to prevent the influenza virus infection.

P79 Fructan and arabinoxylan in malting and brewing of wheat and rye

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SUMMARY

Fructans and arabinoxylans are two dietary fiber fractions, that naturally occur in wheat and rye and thus in malt and beer made of them. The aim of this work was the enrichment of these components to provide their beneficial health effects to the consumer. Therefore the concentration of water-soluble arabinoxylan as well as the concentration of fructan during malting and brewing process was determined. During the malting process the amount of soluble dietary fiber increased. During the brewing process no relevant changes in the total amount of soluble dietary fiber could be observed.

P80 Effect of processing, fermentation and ageing on folate content of various types of beer

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SUMMARY

In a nutritional approach of beer, screening of folates was enlarged to lagers, wheat, speciality, acid, low alcohol and fruit beers. Vitamin levels greatly differ from one type to another, partially depending on alcohol volume, and decrease slowly in aged beers. During industrial production, recovery of B9 from malt was nearly complete. Fermentation step increased folates up to 50 % depending on yeast strain and metabolism. Minimal loss was observed after centrifugation and flash pasteurisation. For brewers seeking to preserve vitamin content of their beer, it is highly useful to better understand folate synthesis and evolution through beer processing and storage.

P81 Brewing at room temperature - a strategy to increase the nutritional value of beer

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SUMMARY

Beer is a good source of vitamins - but it could be better. These vitamins come from the malt but many of these are destroyed by heat during processing i.e. the more heat, the less nutrients. In this project, we ask whether we could reduce heating during brewing to improve its nutritional content. Using innovative problem solving combined with information searching as a tool, we describe the recent advances in engineering and bioengineering might allow us to brew at lower temperatures, and challenge the paradigm that heat is necessary to make beer. Could this lead to a more nutritious pint?

MICROBIOLOGY

P82 Effects of morphological changes in beer spoilage lactic acid bacteria on microbiological control in breweries

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SUMMARY

Membrane filter performance was investigated using beer spoilage lactic acid bacteria. As a result, beer-adapted *Lactobacillus brevis* and *L. lindneri* showed considerably increased penetration rate through filters, as compared with non-adapted strains. Statistical analyses demonstrated the significant shifts in cell size distribution towards shorter rods when those strains were precultured in degassed beer. Therefore, diminished cell size is responsible for the deteriorated filter performance and beer-adapted lactic acid bacteria pose a serious threat to the production of unpasteurized beers. In addition, the selection of the test strains and preculture conditions are important in evaluating the performance of membrane filters in breweries.

P83 Hop resistance in beer spoilage lactic acid bacteria (LAB) and other related quality assurance issues - a review

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SUMMARY

Hop resistance of beer-spoilage LAB is known as complex phenomena, consisting of multidrug transporters and proton-translocating ATPase that counteract the protonophoric actions of hop bitter acids. To supply energy sources for these defense systems, metabolism of organic acids and arginine is involved in beer. These hop resistance mechanisms have been recently implicated in larger quality assurance issues concerning beer-spoilage LAB, such as the induction of viable but nonculturable states and the deteriorated membrane filter performance caused by morphological changes in beer-spoilage LAB. In this review, these issues surrounding microbiological QC problems will be described in one big picture.

P84 The use of genetic tools to differentiate related lager yeast strains

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SUMMARY

Lager strains are difficult to differentiate as they form a genetically conserved group. A variety of molecular methods, targeting different regions of the genome, were compared for their ability to differentiate 8 commercially available, and particularly closely related lager yeasts. It was observed that although no single method was able to differentiate between the 8 strains, each yeast was identifiable using a combination of techniques. A comparison of the efficacy of each method suggested that microsatellite PCR may be the most discriminant method. It is anticipated that the techniques described in this study could be implemented for quality control purposes.

P85 Assessment of brewing yeast age based on selective bud scar staining and subsequent fluorescence measurement by flow cytometry

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SUMMARY

To study the yeast cell ageing in continuous fermentation processes has a considerable practical significance. Hence, an expeditious method of yeast age estimation would allow taking measures against the adverse effects of biocatalyst ageing and loss of viability on product quality. The number of bud scars on cell surface represents a biomarker for replicative cell age estimation and it was determined by selective bud scar staining and subsequent fluorescence intensity measurement by flow cytometry. The bud scar accumulation in immobilized biomass was then used for scheduling the regular replacement of “old” biocatalyst by clean carrier during long-term continuous beer fermentation.

P86 PCR-DHPLC (Denaturing High Performance Liquid Chromatography): a potential novel method for rapid screening of mixed yeast populations

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SUMMARY

The rapid detection, identification and separation of spoilage and brewing yeasts is of serious interest in the quality control of the beer production process. The potential of the PCR-DHPLC method was studied to determine the presence of spoilage yeast populations in single and mixed cultures. PCR was performed with universal primers amplifying the ITS1 and ITS2 rRNA genes of yeast species within a mixed population, followed by DHPLC to separate the different PCR. Applying this method, all 29 yeast strains tested were clearly separated from each other, showing the potential of PCR-DHPLC in the quality control process.

P87 Gathering beer spoiling microorganisms by using an adsorbing granulated polymer

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SUMMARY

We tried to establish a new method by using a granulated polymer with functional groups on its surface, enabling it to adsorb the most important beer spoiling MOs. The specially treated polymer granulates enabled us to gather even the tiniest amount of cells contained in high volumes of beer. The viscosity of the medium was much less important than for membrane filtration. The bound MOs can still be enriched in common media, so the polymer can be used with classic detection methods (e.g. microscopes) as well as with PCR systems.

P88 Real-time multiplex PCR assay for simultaneous detection and differentiation of beverage spoilage bacteria and yeasts

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SUMMARY

A new rapid real-time multiplex PCR assay detects and differentiates beer spoilage bacteria and yeasts in one test within a few hours. It is the first system which allows the simultaneous detection of both types in routine analysis of the brewing industry with highest level of information. Time-consuming cultivation steps are no longer needed, results are getting fast, specific and sensitive and allows to react on microbial contaminations within a reasonable period of time. Testing of several type strains and routine samples showed the suitability, reliability and robustness of the assay, which is already routinely applied.

PRODUCT SAFETY

P89 Fate of pesticide residues of hops during the brewing process

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SUMMARY

During the last few years the use of pesticides for hop cultivation has changed considerably. New active agents are applied nowadays and may lead to residues in hops. In brewing trials the fate of the residues were traced throughout the whole process in a pilot brewery. Besides hop pellets with original pesticide residues additionally pellets spiked with active agents (at the maximum residue level) were used. Furthermore the chosen hopping rate was rather high to simulate a worst case scenario. Under these conditions some active agents can result in measurable residues at different steps during the brewing process and also in finished beer.

P90 Barley malt beer rendered gluten free

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SUMMARY

Barley malt is the natural raw material for beer production. The susceptibility of the beer to coeliac depends on the beer type, raw materials and processing methods used. In the study the gluten content of several European beers were analyzed by western blots and two R5-ELISA methods. The results showed that the sandwich method is not suitable for detecting hydrolyzed hordeins in beers; instead a competitive R5-ELISA, especially developed to detect gluten in processed foods, should be applied. In addition a controlled brewing process was developed, where beers repeatedly have gluten levels well below the limit for natural gluten-free products.

P91 Detection of *Fusarium trichothecene* biosynthesis using a novel transcript analysis method TRAC

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SUMMARY

Several *Fusarium* species are capable of producing mycotoxins, which can accumulate in infected grains. Expression of genes related to growth, protein synthesis and degradation and particularly mycotoxin biosynthesis were followed in different *Fusarium* species in liquid media with the TRAC method. Some trichothecene biosynthesis genes showed increasing expression towards the end of the 2-3 week cultures, after growth was stopped. T-2 and DAS mycotoxins were detected in cultures with high expression levels of the tri -genes. Data shows the potential of the TRAC for screening of mycotoxin production related genes in different *Fusarium* species and in different environmental conditions.

P92 New origin of 3-MCPD in beer: beer filter sheets

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SUMMARY

The carcinogenic contaminant 3-MCPD found in beer comes from special malts. But residues were found in pils beers (brewed without special malts). A survey at the pilot scale showed that filter sheets release 3-MCPD. This release, depending on the filter sheets origin, ranges from 300 µg/kg to 12000 µg/kg. To prevent 3-MCPD in pils beer, filter sheets with low amounts of 3-MCPD should be used and filter sheets should be washed before beer filtration.

P93 T2 and HT2 toxins inhibition during the malting process by use of *Geotrichum candidum*

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SUMMARY

T2 and HT2 toxins are found in malting barley since only few years. During malting process, these mycotoxins are eliminated during steeping and synthesis de novo during germination and kilning by *Fusarium* naturally present in barley. Fungi contaminated barley samples were malt with and without *Geotrichum candidum*. In presence of *Geotrichum candidum* during the malting, T2 and HT2 toxins synthesis was inhibited. In order to prevent the economic loss and public health problems associated with those mycotoxins, the addition of *Geotrichum candidum* IFBM Malting Yeast in steeping water could inhibit this synthesis of toxins and enhanced control of malting process.

P94 A novel Homogeneous Enzyme Immunoassay for rapid on-site analysis of deoxynivalenol (DON) in grain

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SUMMARY

A new on-site test for deoxynivalenol (DON) was developed using a novel homogeneous enzyme immunoassay (HEIA) method. The test mechanism is described in detail and data is presented comparing the test's performance with commercial ELISA kits using grain samples (barley, malted barley and wheat) naturally contaminated with DON at levels determined by HPLC and GC-MS analysis. The accuracy and precision of the DON HEIA test was found to be consistently equivalent to the corresponding ELISA systems. These results indicate that the new HEIA test can be effectively used for on-site DON testing and offers additional advantages of speed and simplicity.

P95 A quantitative screening test for *Fusarium* contaminations allowing the quantification of toxin producing *Fusarium* species in grain and malt

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SUMMARY

Fusarium species as the main group of toxin producers are relevant in the malt and beer production, and contaminations with *Fusarium* are frequently in discussion to contribute to Gushing. A new DNA based screening test was developed (multiplex PCR) which allows both the measurement of total *Fusarium* amount and simultaneously the amount of the toxin producing subgroup of *Fusarium*. A correlation to the beared toxin hazard (DON content) was shown by parallel analyses with PCR and ELISA. The PCR test can be used as a routine testing to predict the hazard potential due to *Fusarium* contaminations in grain and malt.

NEW TECHNOLOGIES

P96 Advantages of whole grain conditioning for milling with roller mills and lautering with a lauter tun

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SUMMARY

Combine the technical and technological advantage of wet / steep conditioning milling, which means steeping of the malt up to > 10 % water content, for husk and germ protection, with the advantage of dry milling, easy control of grist composition and flexible reaction of different malt quality by adaptation of the minimum 2, in normal case 3 roller gap settings. Germ and husk will remain most complete during milling and mashing. Reduction of lipids and polyphenols were analysed which gives benefit for wort and beer quality.

P97 Technical and technological advantages of producing high-quality wort from malt without germs and husks

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SUMMARY

As known from several publications a lot of quality benefit is reached, if the influence of lipoxygenase is reduced or completely eliminated. The target of the new technology is to protect the mash against fatty substances and polyphenols by using a peeling unit and by integrating this unit into existing brewhouses or into a process with fine wet milling and lautering with a mash filter which means wort production is possible without husks and without the germs.

P98 Finding the real bottleneck – diagnosis for fault localisation in bottling plants

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SUMMARY

For optimising bottling plants, it is important to know the weak spots of the production line. To find the efficiency reducing aggregates or processes, one has to observe the product flow along the whole line. The goal of the current work is to do the fault localisation in the plant automatically by using methods of artificial intelligence (AI). Different AI-systems are used and evaluated to find an easy and reliable way for diagnosis. The results can help to increase the operating time of the plant by reducing downtimes of the central aggregate.

P99 New aspects in labelling performance

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SUMMARY

The knowledge about label wrinkling was based only on empirical values. This is the first scientific work that analyses all involved components under realistic environmental circumstances. It has been found, that a well balanced interaction between wet-expansion and dry-contraction on one side and setting of labelling glue on the other side, is the basic requirement for wrinkle free labelling. This balance has to be adjusted to the unique environmental conditions of each brewery. When label wrinkling appears it can be countersteered by raising the amount of labelling glue to expand the dry-contraction time of the label.

P100 The new and highly developed system of single beam laser marking and inspection for printing of freshness date on beer bottle label

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SUMMARY

We have developed the new system of single beam laser marking and inspection for printing of freshness date on beer bottle labels. Comparing to conventional laser marking system, this new system is featured on both the minimum electric energy consumption by using single beam laser rather than area laser on engraved slit and the assurance for correctness of printing on beer label. Annual running cost has been reduced by 15,000 EURO because single beam laser system is based on free maintenance for a decade. The characters of this new single beam laser printings look so familiar like those of human handwriting.

P101 Development of mixed culture fermentation strategy for the production of organic acids in beverages

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SUMMARY

New beverages on the base of wort have been developed by mixed fermentation. The formation of the health benefiting gluconic and L-(+)-lactic acid can be achieved simultaneously by mixed fermentation of the strictly aerobic acetic acid bacteria and the anaerobic lactic acid bacteria. At very low aeration rates it is possible to control the formation of both organic acids. The selected yeast is responsible for the flavour formation. These developed fermentation strategy leads to fruity, fresh sparkling beverages which provide new markets for breweries.

P102 Computer aided production planning and scheduling

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SUMMARY

Especially in brewing science the integration of knowledge intensive approaches to modelling such as neural networks, cognitive algorithms, data mining and advanced statistical analysis results in a new hybrid system designed for production planning and process simulation. The framework for the integration delivers a simulation environment able to solve classic scheduling and investment tasks as well as complex scenarios containing the interdependency of multiple clusters of both technological parameters and varying raw materials. The calculations can be done using an up-to-date office pc within reasonable time, depending on the complexity of the given problem.

ENVIRONMENT

P103 Comparison of bottled and kegged beer: the LCA approach

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SUMMARY

LCA practise was applied to an Italian lager beer in order to compare the eco-performances of bottled (non-returnable 33 cl glass bottles) and kegged (returnable 20 l steel kegs) beer from barley cultivation to use phase. Beer in kegs resulted to be preferable than beer in bottles because of the packaging difference. Use phase and barley cultivation were found to be other two critical stages in the beer life cycle, while beer production do not seem to be worrying. A more responsible consumption and an environmentally more respectful production can be achieved orientating people towards to draught beer and reusable packaging.

P104 Manufacturing control by energy performance figures

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SUMMARY

Today's energy performance figures can be imprecise as a result of ignoring daily production characteristics and outside influences. A new approach based on the ratio of real and theoretical energy demand is introduced. After analysing energy flows and the impact of production and outside parameters the theoretical energy demand of a brewing plant can be calculated. From the resulting difference to the real energy consumption a fault analysis of the production steps as well as the definition of a "best practice" can be performed. The introduced system can be implemented in existing energy management systems.