Beer production

Food & Diet

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Quality Control in Beer Production 3 Kool Breweries Ltd: An Overview Kool Breweries Limited is a premium-branded beverage company dedicated to delivering quality products enjoyed by millions around the world every day. Anacademicvisit to the Kool Brewery manufacturing plant in Haryana was organized as a part of the course ‘ Biotech Plant Site Layout’ on the 19th March 2007. This visit provided with the opportunity to observe the different processes involved in the beer manufacturing, i. e. mashing, lautering, whirl pooling, fermentation, filtration and packaging.

Also the quality control measures being adopted to maintain the quality of the beer to international standards and the basic layout of the plant were also observed. The visit was a very useful academic as well as practical exposure and we look forward to more of such visits in future to enhance both our theoretical, technical and practical knowledge. 4 Alcoholic Beverages An alcoholic beverage containing ethanol. is a drink Ethanol is a psychoactive drug, a depressant, and many societies regulate or restrict its sale and consumption.

Countries place various legal restrictions on the sale of alcoholic drinks to young people. The manufacture and consumption of alcohol is notably found (to some degree) in most cultures and societies around the world, from hunter-gatherer tribes to organized nation-states. The consumption of alcohol is often important at social events in such societies and may be an important aspect of a community'sculture. The concentration of alcohol in a drink may be specified in percent alcohol by volume (ABV), in percentage by weight (sometimes abbreviated w/w for weight for weight), or in proof.

Most yeast cannot grow when the concentration of alcohol is higher than about 18% by volume, so that is a practical limit for the strength of fermented beverages such as wine, beer, and sake. Strains of yeast have been developed that can survive in solutions of up to 25% alcohol by volume, but these were bred for ethanol fuel production, not beverage production. 5 Alcoholic Beverages • Mead - fermented honey and water, sugar in honey is too concentrated for yeasts to grow so it must be diluted. Probably made by early humans by accident initially.

Mead is made now by boiling diluted honey and adding nitrogencontaining compounds, then yeast culture. Fermentation process takes 6-8 weeks. • Wine - Yeasts are present on fruit skins so fermentation can occur naturally. Wine was probably produced accidentally as long as 10, 000 ybp but that is only a guess. • Beers - have been made for at least 6000 years. Brewing has been a hit and miss process until about 200 years ago, until then it was difficult to control quality. High quality beer has three basic ingredients: barley malt, hops, and water. Adjuncts are used extensively in cheap beers. 6 Sake - " rice wine" - Conversion of rice starch to sugar is done by

Aspergillus (bread mold). Yeast are then added for fermentation, final alcohol concentration is 19% and is fortified to 20-22%. • Chicha - corn beer, Central and S. America, made from chewed corn. • Distillation o Whiskeys - distilled from " beers" and aged - Scotch, Bourbon, Rye. o Cognacs and brandies - distilled from wines. o Grain alcohol is 95% = 190 proof o Gin and vodka - ethanol + water, gin is flavored. o Rum - fermented molasses or sugarcane juice 7 Brewing: How Beer is Made Brewing is the production of alcoholic beverages and alcohol fuel through fermentation.

This is the method used in beer production. Brewing is fundamentally a natural process. The art andscienceof brewing lies in converting naturalfoodmaterials into a pure, pleasing beverage. Although great strides have been made with the techniques for achieving high-quality production, beer today is still a beverage brewed from natural products in a traditional way. Although the main ingredients of beer have remained constant (water, yeast, malt and hops), it is the precise recipe and timing of the brew that gives one a different taste from another.

The production of beer is one of the most closely supervised and controlled manufacturing processes in our society. Apart from brewing company expenditures on research and quality control designed to achieve the highest standards of uniformity and purity in the product, the production of beer is also subject to regular inspection and review by federal and provincialHealthDepartments. Substances used in the brewing process are approved by Health Canada. On average, a batch of beer will take about 30 days to produce.

To be more specific, brewing takes nine and a half hours, while fermentation and aging combined take between 21 and 35 days for ales and lagers respectively. 8 Brewing: Process Overview The grain used as the raw material is usually barley, but rye, maize, rice and oatmeal are also employed. In the first stage the grain is malted, either by causing it to germinate or by artificial means. This converts the carbohydrates to dextrin and maltose, and these sugars are then extracted from the grain by soaking in a mash tun (vat or cask) and then agitating in a lauter tun.

The resulting liquor, known as sweet wort, is then boiled in a copper vessel with hops, which give a bitter flavour and helps to preserve the beer. The hops are then separated from the wort and it is passed through chillers into fermenting vessels where the yeast is added-a process known as pitching-and the main process of converting sugar into alcohol is carried out. (For discussion of fermentation see the chapter Pharmaceutical industry.) The beer is then chilled to , centrifuged and filtered to clarify it; it is then ready for dispatch by keg, bottle, aluminium can or bulk transport. Figure 65. 8 is a flow chart of the brewing process. Beer Production: Flowchart 10 Beer Production: Ingredients The water must be pure, with no trace of bacteria. This is vital, because it allows the other ingredients to release all their flavour. 95% of breweries have their own spring or natural well. Barley is a cereal that offers a key advantage: it can be preserved for a long time after harvesting. In order for barley to be used in the making of beer, it must first be malted. It is malted barley that gives beer its characteristic color and taste. Hops or “ green gold” come from a climbing plant with male and female flowers; only the female flowers are used.

There are various varieties, ranging from very bitter to aromatic. Hops grew naturally in our regions in ancient times, and this plant has been used by brewers since time immemorial. In antiquity, it could be replaced by mixtures of aromatic herbs, in particular rosemary and thyme, which had the same preserving effect as hops but of course gave the resulting beverage a quite different flavour. Yes, it is hops that give beer its characteristic bitterness, and this plant became so successful that in the 18th century all varieties of beer contained hops. 11 Yeasts transform the sugars in the must into alcohol and carbon dioxide.

The type of yeast used varies according to the type of beer. There was a time when man had no control over yeasts in beer. Louis Pasteur was able to explain their role in the brewing process, and yeast culture was developed thanks to the work of the Danish scientist Hansen. Nowadays there are two main varieties of yeasts that are used in brewing: saccharomyces cerevisiae and saccharomyces carlsbergensis (bottomfermenting). Certain other products are used in the making of beer, in particular spices: coriander, ginger, cloves, sage, fennel, mustard seeds, aniseed, cinnamon, etc. 12 Beer Production Process Mashing

Malt is added to heated, purified water and, through a carefully controlled time and temperature process, the malt enzymes break down the starch to sugar and the complex proteins of the malt to simpler nitrogen compounds. Mashing takes place in a large, round tank called a " mash mixer" or " mash tun" and requires careful temperature control. At this point, depending on the type of beer desired, the malt is supplemented by starch from other cereals such as corn, wheat or rice. Lautering The mash is transferred to a

straining (or lautering) vessel which is usually cylindrical with a slotted false bottom two to five centimetres above the rue bottom. The liquid extract drains through the false bottom and is run off to the brew kettle. This extract, a sugar solution, is called " wort" but it is not yet beer. Water is " sparged" (or sprayed) though the grains to wash out as much of the extract as possible. The " spent grains" are removed and sold as cattle feed. 13 Boiling and Hopping The brew kettle, a huge cauldron holding from 70 to 1, 000 hectolitres and made of shiny copper or stainless steel, is probably the most striking sight in a brewery. It is fitted with coils or a jacketed bottom for steam heating and is designed to boil the wort under carefully-controlled conditions.

Boiling, which usually lasts about two hours, serves to concentrate the wort to a desired specific gravity, to sterilize it and to obtain the desired extract from the hops. The hop resins contribute flavour, aroma and bitterness to the brew. Once the hops have flavoured the brew, they are removed. When applicable, highly-fermentable syrup may be added to the kettle. Undesirable protein substances that have survived the journey from the mash mixer are coagulated, leaving the wort clear. Hop Separation and Cooling After the beer has taken on the flavour of the hops, the wort then proceeds to the " hot wort tank".

It is then cooled, usually in a simple-looking apparatus called a " plate cooler". As the wort and a coolant flow past each other on opposite sides of stainless steel plates, the temperature of the wort drops from boiling to about 10 to 15. 5 °C, a drop of more than 65. 6 °C, in a few seconds. 14 Fermentation The wort is then moved to the fermenting vessels and yeast,

the guarded central mystery of ancient brewer's art, is added. It is the yeast, which is a living, single-cell fungi, that breaks down the sugar in the wort to carbon dioxide and alcohol. It also adds many beer-flavouring components.

There are many kinds of yeasts, but those used in making beer belong to the genus saccharomyces. The brewer uses two species of this genus. One yeast type, which rises to the top of the liquid at the completion of the fermentation process, is used in brewing ale and stout. The other, which drops to the bottom of the brewing vessel, is used in brewing lager. During fermentation, which lasts about seven to 10 days, the yeast may multiply six-fold and in the open-tank fermenters used for brewing ale, a creamy, frothy head may be seen on top of the brew. 15 Filtration

Filtering the beer stabilizes the flavour, and gives beer its polished shine and brilliance. Not all beer is filtered. When tax determination is required by local laws, it is typically done at this stage in a calibrated tank. Filters come in many types. Many use pre-made filtration media such as sheets or candles, while others use a fine powder made of, for example, diatomaceous earth, also called kieselguhr, which is introduced into the beer and recirculated past screens to form a filtration bed. Filters range from rough filters that remove much of the yeast and any solids (e. . hops, grain particles) left in the beer, to filters tight enough to strain color and body from the beer. Normally used filtration ratings are divided into rough, fine and sterile. Rough filtration leaves some cloudiness in the beer, but it is noticeably clearer than unfiltered beer. Fine filtration gives a glass of beer that you could read a newspaper through, with no noticeable cloudiness. Finally, as its name

implies, sterile filtration is fine enough that almost all microorganisms in the beer are removed during the filtration process. 16 Packaging

In the bottle shop of a brewery, returned empty bottles go through washers in which they receive a thorough cleaning. After washing, the bottles are inspected electronically and visually and pass on to the rotary filler. Some of these machines can fill up to 1, 200 bottles per minute. A " crowning" machine, integrated with the filler, places caps on the bottles. The filled bottles may then pass through a " tunnel pasteurizer" (often 23 metres from end to end and able to hold 15, 000 bottles) where the temperature of the beer is raised about 60 °C. or a sufficient length of time to provide biological stability, then cooled to room temperature. Emerging from the pasteurizer, the bottles are inspected, labelled, placed in boxes, stacked on pallets and carried by lift truck to the warehousing areas to await shipment. Also in the bottle shop may be the canning lines, where beer is packaged in cans for shipment. Packaged beer may be heat-pasteurized or micro-filtered, providing a shelf-life of up to six months when properly stored. Draught beer, since it is normally sold and consumed within a few weeks, may not go through this process.

The draught beer is placed in sterilized kegs ready for shipment. 17 Quality Control in Beer Production Setting up specifications is done all the time. Brewers decide on the basic properties of original gravity, color, and flavor and from this develop a formulation of raw materials and a process to extract what is wanted from them. Sensory methods: Sensory methods are not necessarily easy to apply (and often ill used) but are useful and quite

cheap to do. They include an analysis of beer flavor (undoubtedly beer's most important attribute), beer clarity, color, and foam.

Brewers who do not regularly and critically taste and visually examine their beers in a formal setting deny themselves much critical information. Beer color, on the other hand, can be measured in a comparator (just a light box set up for visually matching color - the human eye is much better at this than most instruments) or by quite cheap instruments, such as a tintometer. A standard beer set aside for color matching remains stable for quite a long time if kept cold and in the dark. Observers can rate the beers on some sensory scale.

Putting numerical values from instruments on flavor, haze, foam, color, and so forth is where the trouble starts, but that isn't really necessary for a simple quality-control program. 18 Cycling a beer on some regular schedule (e. g. daily) between a warm place (60° C) and a cold one (40° C) will create haze; more stable beers withstand more cycles than less stable ones. Similarly, storing a beer at 25° C in an archive (a fancy name for a warm cupboard) will encourage microbial growth and other sorts of beer breakdown. Instrumental Analysis: The second kind of specification and analysis is not amenable to sensory testing. gh on this list of " invisible" specifications has to be the original gravity (OG) and the degree of fermentability (hence alcohol content) of beers. These are most easily determined on wort but require an investment in some simple apparatus - a hydrometer and measuring cylinder. The wort OG and fermentability are fundamental specifications for a beer, because beer is made from the fermentable portion of the wort. These values also allow a brewer to

calculate extract yield from raw materials (brewhouse yield) and predict beer yield.

The degree of fermentability can be determined by a rapid fermentation test in which a high population of yeast cells, with frequent agitation, rapidly ferments out the wort. At the same time, wort flavor and clarity can be noted. A sample of wort, taken under aseptic conditions and set aside in the archive, will reveal its microbiological status in a few days and tell a good deal about the sanitary status of the brewhouse. Package beer, on the other hand, must be analyzed for CO2 content (carbonation) and bottle " air" for flavor stability. 19

The microbiological status of a packaged beer, especially one destined for a distant market, is of prime concern for beer flavor and for the safety of the consuming public (potential for exploding bottles). The only satisfactory microbiological test is to pass at least 100 ml of beer through a 0. 45 micrometer membrane, then plate the membrane on media (such as MRS) under conditions (for instance anaerobic at about 25° C) capable of detecting the target organisms in low numbers. A quick squint at a beer sample under a microscope doesn't cut it. 20