EUROPEAN BREWERY CONVENTION

MONOGRAPH 27

E.B.C. SYMPOSIUM
BEER FOAM QUALITY
AMSTERDAM, THE NETHERLANDS
OCTOBER 1998

Published by
FACHVERLAG
HANS CARL

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INDEX OF DESCRIPTORS

GENERAL DISCUSSION

A.C. DOUMA, General Chairman

During the general discussion two statements were debated. The first statement was: '*In beer foam research insufficient attention is paid to the consumer*'. In general this statement was endorsed by the participants. More attention is required for:

- input from a marketing perspective: a good insight into consumers wishes, and their market-dependency;
- teaching the consumer how to dispense beer properly;
- reproducible methods for dispense and analysis, that can be used in research and are representative for consumer observation. For analytical purposes, the availability of well-characterized European standards with regard to foam quality would be very helpful;
- foam formation, texture of foam, foam lacing (cling);
- consistency of the quality of beer foam;
- robustness of the foam: protection against destabilizing external influences.

Attention should not be limited to the aspects that are directly observed by the consumer. The effect of the brewing process on foam quality should also be studied. In particular the effect of yeast metabolism on beer foam stability and good manufacturing practice with regard to beer foam were named.

The second statement was '*The attention for beer foam research will remain at the present level*'. The prevailing expectation of the participants of the Symposium was that this would indeed be the case, this despite the observation that younger drinkers tend to drink beer more from the bottle. A continuing interest for beer foam research was predicted based on the following considerations:

- foam is an important characteristic in which beer discriminates itself from other beverages;
- the interest for beer foam quality will remain until a better control of foam quality will have been obtained: delivering a particular type of foam for a particular type of beer and a particular type of consumer;
- increased competition between breweries leads to increased interest for characteristics that are directly observed by the consumer;
- although foam stabilizing ingredients are available on the market, these do not form the solution for foam quality management: their use is not always accepted and furthermore the need for cost reduction is a driving force for better foam stability based on the raw materials only.

The type of beer foam research is expected to change in future. Biochemical and physical research should no longer be separated, but should be integrated more and more. It may also be possible to learn from the experience that is already available for other types of foam. When the major players in beer foam stability can be identified, this opens the way for designing breeding programmes towards raw materials which can provide an improved foam stability in the beer.

SESSION I

General

Session Chairman: A.C. Douma

1. BRINGING MATTERS TO A HEAD: THE STATUS OF RESEARCH ON BEER FOAM

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Descriptors: beer constituent, foam, foam stability, measurement, other beer components, physics, polypeptide, process effects, quality assurance, research and development, review

This paper is dedicated to Mike Proudlove.

Summary

The most dramatic way in which beer foam can be improved is by attention to physical aspects, such as the determination of constant small bubble size on dispense. Studies of beer composition in relation to foaming have been hampered by the shortage of thoroughly good methods for assessing foam stability. Partly because of this, there is significant disagreement in the literature about whether foam quality relates to one or a very few proteinaceous species in beer or to the overall level of hydrophobic polypeptides, irrespective of their other properties. It appears that foam negative factors, such as lipids and proteolytic enzymes from yeast, are likely to be more important chemical determinants of foam quality than the level of polypeptide *per se*.

Introduction

It seems to have become customary to start papers on beer foam with a statement along the lines of: "foam is a critical feature of beer quality".

A recent visit to a nearby bar, however, demonstrated to me quite forcibly that, at least for the younger drinker, foam is a total insignificance, for the simple reason that beer drinking has for them become a peer pressure issue in which 'street credibility' is achieved through drinking premium products directly from the bottle.

Assuming that these customers don't modify their drinking habits as they become older (and wiser?), it is my prediction that the literature on beer foam will progressively decline in years to come. Perhaps research will primarily concentrate on the influence which foaming can have on beer flavor delivery (apart from indirect effects, 1). Ono and her colleagues made a start on this, suggesting that tasters preferred to drink through foams with finer bubbles (2). Langstaff & Lewis showed that drinkers could detect a tactile effect of foam on the upper lip, which effect may influence their judgments concerning the flavor of a beer (3).

The very fact, however, that we are gathered here to discuss the complex issue of beer foam forces me to conclude that a head on beer is still a major issue for many brewers and for beers in many parts of the world. It tells me, too, that there is still plenty of research to do if we are to conquer the vagaries which surround this most challenging of quality issues.

In this paper I seek to make a position statement on the status of research on beer foam (hopefully as a useful update to the earlier review (4)) and to highlight where I believe the gaps and weaknesses lie.

Assessment of beer foam

Perhaps the biggest need is for a decent method for assessing foam quality. Many methods have been put forward (a sure sign that none of them even approaches perfection) but none is universally accepted as a yardstick of foaming performance.

Good methodology is needed for Quality Assurance/Quality Control purposes, to tell the brewer whether the beer will behave well in the trade. The problem, of course, is that most problems with beer foam in the trade are not caused by weaknesses in the beer, but rather due to bad practice behind the bar or in the home: dirty glasses or lines, residues of detergents, incorrect gas pressures, badly adjusted taps etc.

Suitable methods are also needed to allow good research on beer foam to be undertaken. The fact is that separate laboratories use different methods for quantifying foam, with the usually overlooked consequence that different conclusions may be drawn by different researchers.

For QC/QA purposes the most frequently used methods world wide are the procedures of Rudin (5), Ross & Clark (6) and that from NIBEM (7). Remarkably, it has been demonstrated for a limited yet diverse range of beers that these and other methods rank foam quality in a similar order (8). Whilst the Analysis Committee of the Institute of Brewing has concluded that both the NIBEM and manual Rudin procedures could be included in their Methods of Analysis, they nonetheless highlighted the fact that the two methods ranked the three beers studied in a different order (9). However, through sustained use of and loyalty to a single procedure, most laboratories have convinced themselves that they have a tool which will at least pick out the batches of beer likely to cause a problem in the trade.

This author would contend that decisions on whether to release beer to trade are most rapidly and effectively made by little more than a shaking test. A fixed volume of finished beer is shaken in a closed cylinder and allowed to stand for a few minutes. Any beers with severe foam problems will be evident from the appearance of the head. Such a test should be applied to representative batches from all bright beer tanks and packaged beers.

For periodic checking of foam quality and surveying of trends, it is desirable to employ a quantitative procedure. Intuitively it must be right to employ a method which takes into consideration all of the parameters which will have a final bearing on foam quality. Thus, for example, the Rudin procedure suffers from the fact that it uses degassed beer and thus makes no allowance for the foam enhancing properties of nitrogen gas (which may be used to enhance foam stability) or indeed the foamability variation due to different degrees of carbonation in a product. The criteria for the ultimate foam measuring procedure or device should take into consideration the following:

1. The characteristics of the foam generated should be analogous to those which will be encountered in the trade, for example volume of head, size distribution of bubbles, gas composition.

2. The foam should be monitored such as to mimic the criteria which the drinker will apply. She will consider size of the foam, its appearance (whiteness and texture, which in turn reflect bubble size), its tendency to survive as the beer is progressively drunk (both in terms of depth of foam and its coverage of the beer surface) and, finally, the tendency of the foam to adhere to the side of the glass (lacing or cling).

The cynic would say that such methodology is available, and consists of nothing more than a representative pouring of the beer followed by visual assessment, either by a panel of experts (analogous to a taste panel) or by use of photography for recording of data. Others have proposed instrumental procedures to record the quality of foams. These methods include microlaser-based recording (10), optical procedures for measuring bubble size (11) and image analysis (12, 13). Irrespective of whether evaluation is through subjective or via sophisticated instrumentation, the challenge is in the representative dispense of the beer.

The single measurement which takes into consideration most of the parameters determining foam quality is of cling. To produce good lacing a beer must produce the appropriate quantity of foam, which must in turn be stable and finally must be capable of clinging to the side of the beer glass. It would surely be logical for a closer examination of methods proposed for the assessment of cling, which include the Lacing Index technique of Jackson & Bamforth (14) and the schaumhaftvermoegen method of Honno et al (15). In either case it is again essential to standardize on a representative dispense procedure.

The physics of foaming

An erstwhile boss of mine once said to me that "generations of biochemists had done less for beer foam than the widget". He was suggesting that the numerous investigations into beer proteins (of which more later) had failed to result in any dramatic improvement in foam quality, whereas the application of some fundamental physical principles such as the use of nitrogen gas and nucleation to promote the formation of many small bubbles was demonstrably able to give outstanding heads on beers, even those of very low carbonation.

It is difficult to contradict this view (whilst defending the fact that *some* surface active materials must be present in beer to support a stable foam). Beer foam is rather more to do with physics than chemistry.

The physics of beer foaming has been most elegantly defined by Prins and his collaborators (16). They have highlighted the significance of the processes of drainage, coalescence and disproportionation in determining the stability of foam. In particular brewers should note the clear conclusions that the most stable foams are those with a homogeneous distribution of small bubbles. If the size population is mixed, then gas will pass from small bubbles to adjacent larger bubbles, in the process known as disproportionation, making the small bubble even smaller until it disappears and the large bubble even larger. The consequence is fewer bubbles (i.e. less foam) and bigger bladdery bubbles which are less attractive. Ronteltap and Prins point out that coalescence (the merging of adjacent bubbles to form one larger bubble) is independent of gas type, whereas disproportionation isn't (17). This enables one to differentiate between the two phenomena in mixed gas systems.

There is a clear need for the research approaches of the physicist and the (bio)chemist to come together. Thus this author is unaware of any substantive attempt to assess the significance of beer composition to the quality of foams produced with different bubble sizes and distributions. Simplistically, what is the influence of bubble size (and therefore liquid to gas ratio) on the tendency of surface-active molecules to move in and out of the bubble wall and to interact with one another once in the wall?

At least we have arrived at a position where relevant physiochemical techniques are being applied to study foaming systems and the properties of molecules in surfaces and thin films, procedures such as surface viscosity (18), fluorescence recovery after photobleaching (FRAP) and dilational rheology (19).