Physical Stability of Beer

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CONCLUSION

Three rapid methods of inducing visual instability of beer (methanol chill, saturated ammonium sulfate, and tannin) failed to correlate with the ASBC BEER-27, three-month room-temperature test (1).

RECOMMENDATION

The subcommittee should continue for another year, to evaluate a modified Chapon (2,4) ethanol chilling test in comparison with the ASBC three-month test.

PROCEDURES

Collaborators were instructed to secure one fresh case of normal production lager beer, to test four samples with each of three rapid methods, and to measure the turbidities with their normal nephelometric procedures. These turbidity measurements formed a baseline for the ASBC three-month test. Samples were stored for three months at ambient conditions and turbidity measured after cooling to 0°C for 24 hr. These tests were repeated four additional times on the same lager beer from different release tanks.

The FTU or Nephelo differential from the three-month test was plotted against each rapid test; each point was an average of four measurements for both the ordinate and abscissa. Each collaborator calculated the five-point regression equation and correlation coefficient for each of the rapid tests vs the ASBC three-month test.

Methanol Chill Test (CH_3OH)

Beer was degassed at room temperature. To 200 ml of beer, 40 ml of reagent grade methanol was added. The mixture was swirled, placed in an ice-bath for 60 min, and mixed or swirled after 30 and 60 min. Turbidity was measured by nephelometry at 0°C. The ASBC procedure (1) or another could be used.

Tannin Protein Precipitation Test

A 100-ppm (mg/L) tannin solution was prepared from the commercial sample of gallotannin sent to each collaborator. Beer was degassed at room temperature and used to zero the

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TABLE I
Correlation Coefficients of Rapid Tests vs ASBC Three-Month Test

Collaborator	Nephelometer	Units	Points[a] (n)	Test		
				CH_3OH[b]	SAS[c]	Tannin[d]
1	Coleman 9	Nephelos	4	0.49	0.58	0.0
2	Coleman 9	Nephelos	5	0.40	0.38	0.22
3	Helm radiometer	FTU	5	0	0.02	0.09
			5	0	0.47	0.05
			3	0	0.76	0.93
			4	0.10	0.93	0.84
4	Coleman 9	FTU	5	0.48	0.18	0.73
5	Helm radiometer	FTU	4	0.89[e]	0.57	···
6	Helm radiometer	FTU	5	0.60	0.72	0.68
7	Coleman 9	FTU	7	0.91	0.95	0.64

[a] Used for correlation. Significance for n at n = 5 is 0.88 (3) at $P = 0.05$.
[b] Methanol chill.
[c] Saturated ammonium sulfate precipitation.
[d] Tannin precipitation.
[e] n = 3.

instruments. Tannin solution (25 ml) was added to 200 ml of beer and the mixture was stirred for 15 min with occasional swirling. Turbidity was measured by nephelometry at room temperature.

Saturated Ammonium Sulfate - Precipitation Test

A saturated ammonium sulfate (SAS) solution was prepared at room temperature. Beer was degassed at room temperature and used to zero the instruments. The SAS solution (50 ml) was added to 200 ml of beer, and the mixture was stirred for 30 min with occasional swirling. Turbidity was measured at room temperature by nephelometry.

Three-Month Test

After three months of storage, the turbidity of beer samples was measured by nephelometry.

RESULTS AND DISCUSSION

The prediction of beer chill stability is important in determining the type and amount of chillproofing treatment to give to beer. In addition, brewing quality control needs a rapid accessment of the turbidity of freshly bottled beer, with a reproducible procedure for the appraisal of shelf life. The objective of this work was to evaluate three rapid (same day) chemical methods of stability prediction to augment the one-week and two-week methods currently used by the industry. The results of correlation studies are shown in Table I.

The first method added reagent grade methanol to form a maximum amount of turbidity. This resulted in difficulty for some of the collaborators, who had to dilute the sample and then apply a dilution factor to measure the turbidity of their samples. One collaborator's laboratory routinely checks for stabilization effectiveness by the addition of 6% denatured ethanol to beer held at 0° C for 30 min. This modification of the Chapon method will be further analyzed by this subcommittee. Use of excess methanol did not exhibit any correlation with the ASBC three-month test, except in the case of Collaborator 7.

The SAS precipitation test was conducted according to a procedure outlined by Simmonds (5) that has been related to the length of time the beer as spent in cellar storage. However, the data showed no relation to the ASBC three-month test. Collaborator 3 exhibited larger values for two products, but this could have resulted from the smaller number of points calculated for these products. If this collaborator's data is grouped, ie, n = 17, lack of significance is apparent. The correlation made by Collaborator 7 for this test was significant.

The tannin precipitation test was conducted according to a procedure outlined by Thompson (6). Larger, but not significant, r values were found by Collaborator 3 for the same products that correlated better with the SAS test. However, none of the collaborators' results were significant with respect to the ASBC three-month test. Tannin for this test was distributed by the chairman, and its solution was prepared by the collaborators immediately before use. This was done because of tannin hydrolytic instability.

Comments by collaborators indicated that both the tannin and SAS precipitation tests were quick and simple to perform but that reproducibility of results from both methods was questionable. The raw data showed the SAS test to be slightly more reproducible than the TANNIN test. The reproducibility problem and the lack of correlation could not be attributed to the instrumentation or turbidity units used by the collaborators.

LITERATURE CITED

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