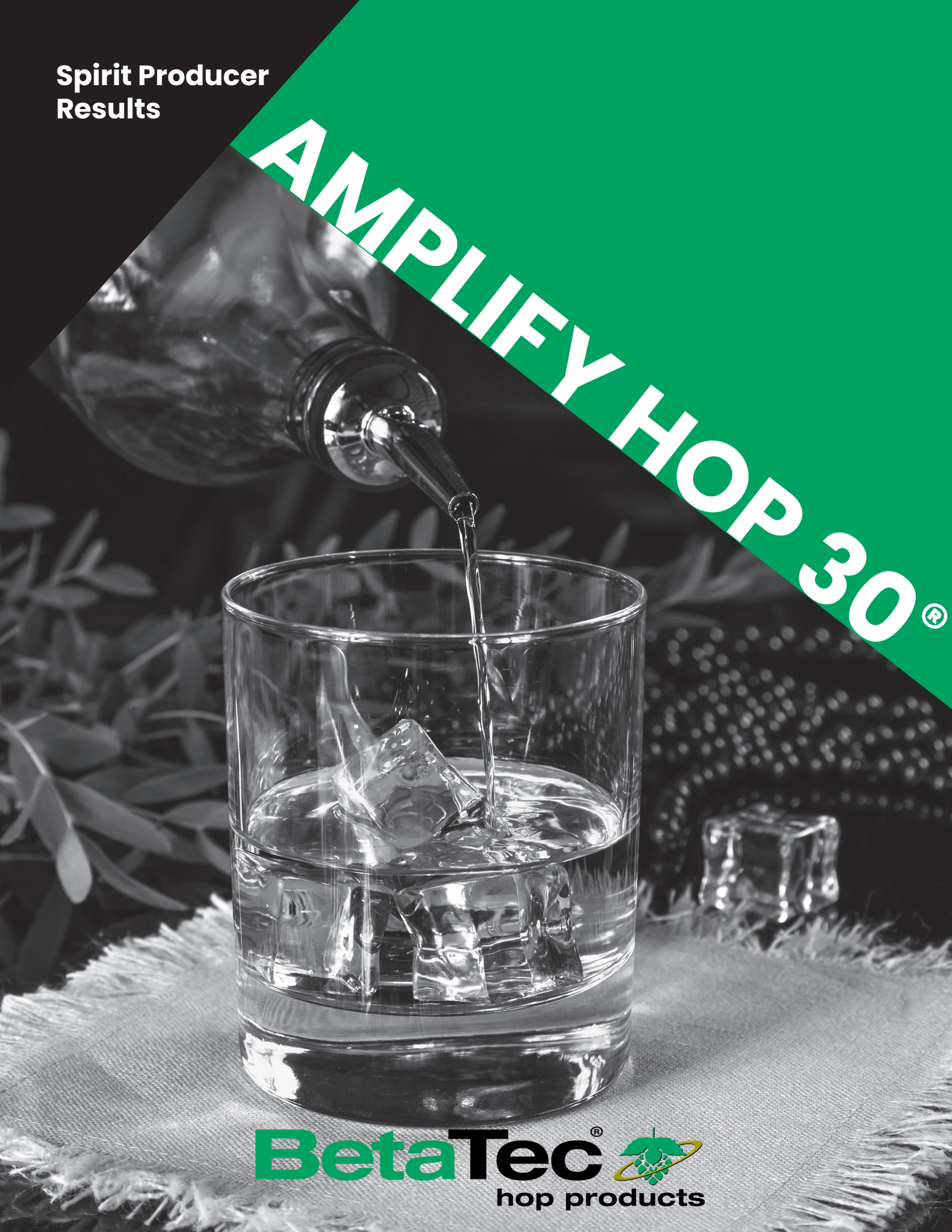
Spirit Producer Results

AMPLIFY HOP 30®

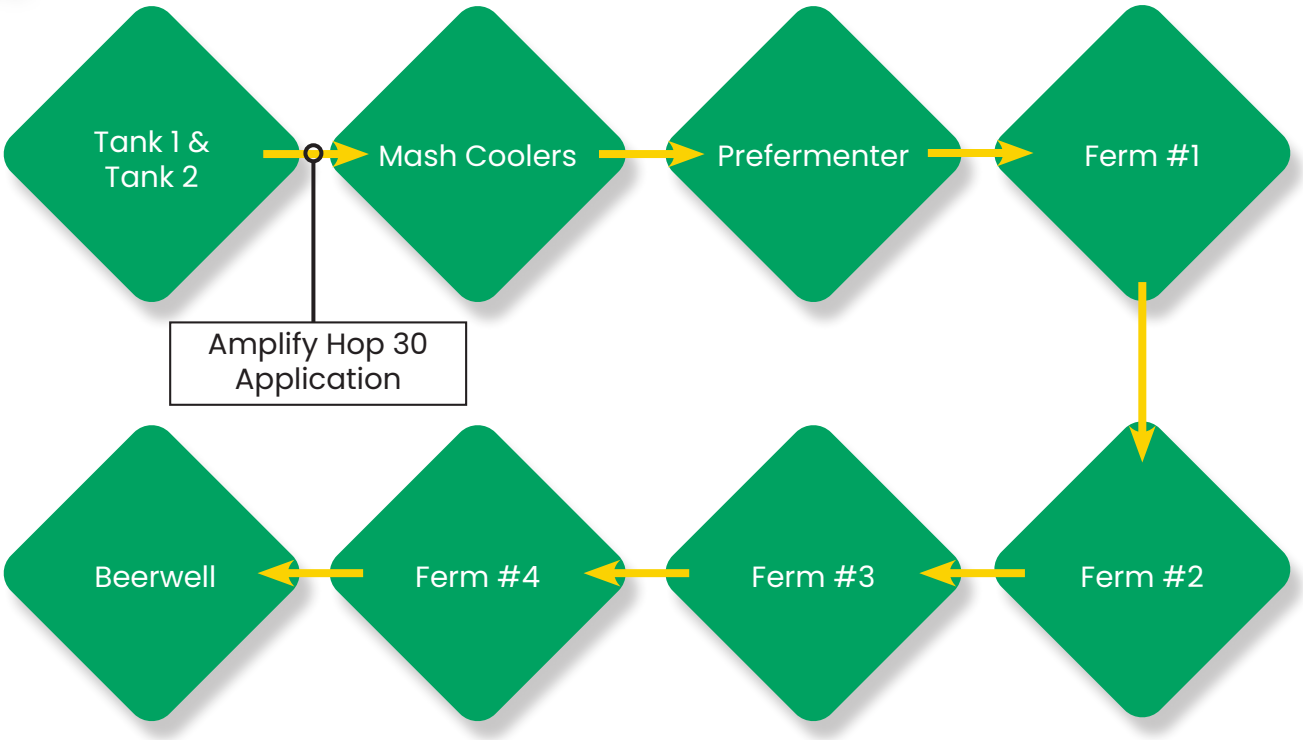


BetaTec® hop products

Amplify Hop 30®

Summary Report

Dosage Location



Trial Summary

Facility X began an Amplify Hop 30 evaluation during early 2020. The time period before the evaluation was analyzed as well in order to observe any ferm trends/impacts on fermentation during the time of the Amplify Hop 30 evaluation. Prior to the Amplify Hop 30 evaluation, the typical antimicrobial program was used at Facility X. Over the course of the evaluation, a single application of Amplify Hop 30 has successfully controlled the LAB at targeted levels for up to 1-3 weeks. The plant also performs weekly sanitation cleaning that will briefly result in lower lactic acid bacteria (LAB) levels seen in fermentation. Overall, when Amplify Hop 30 was implemented, there were positive impacts seen in fermentation. Detailed charts will be outlined below.

Fermentation Analysis

Lactic Acid Bacteria (LAB)

Gram positive Lactic Acid Bacteria (LAB) are contaminating microbes in an ethanol fermentation. They compete with the yeast for nutrients and trace elements. They are detrimental to yeast growth and will ultimately lead to loss in ethanol production. Chart 1 below depicts the historical trends for LAB in the Prefermenter during the pretrial phase of data throughout the ongoing Amplify Hop 30 evaluation. The blue dashed lines in the chart depict the dates that Amplify Hop 30 was applied. LAB appears to be trending down over time. Chart 2 below is a statistical analysis of the averages of LAB for the two different treatment phases (Pretrial and Amplify Hop 30). As the analysis indicates, the lower LAB observed during the time that Amplify Hop 30 is used is significantly different than the pretrial average for LAB.

Chart 1: Prefermenter LAB Control Chart

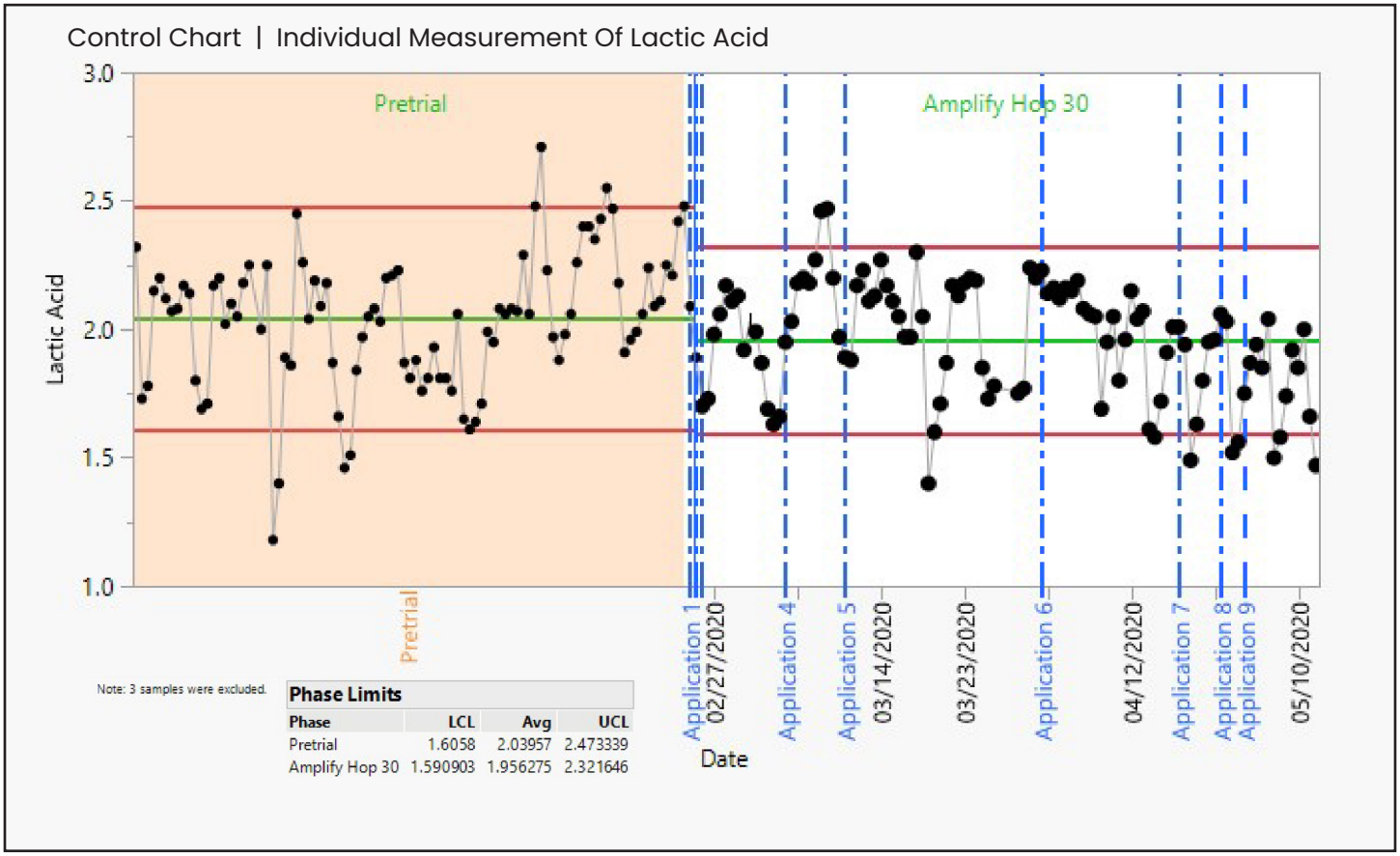
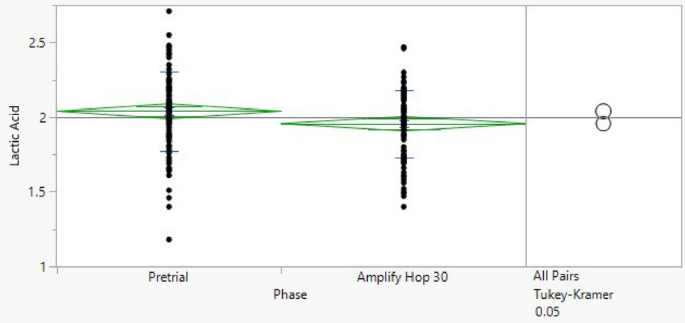


Chart 2: Prefermenter LAB vs. Treatment Phase

Oneway Analysis of Lactic Acid By Phase



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pretrial	93	2.0395699	0.2656735	0.0275491	1.9848551	2.0942847
Amplify Hop 30	102	1.9562745	0.2278871	0.0225642	1.9115132	2.0010358

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Confidence Quantile

q*	Alpha
1.97233	0.05

HSD Threshold Matrix

Abs(Dif)-HSD

	Pretrial	Amplify Hop 30
Pretrial	-0.07133	0.01355
Amplify Hop 30	0.01355	-0.06811

Positive values show pairs of means that are significantly different.

Connecting Letters Report

Level		Mean
Pretrial	A	2.0395699
Amplify Hop 30	B	1.9562745

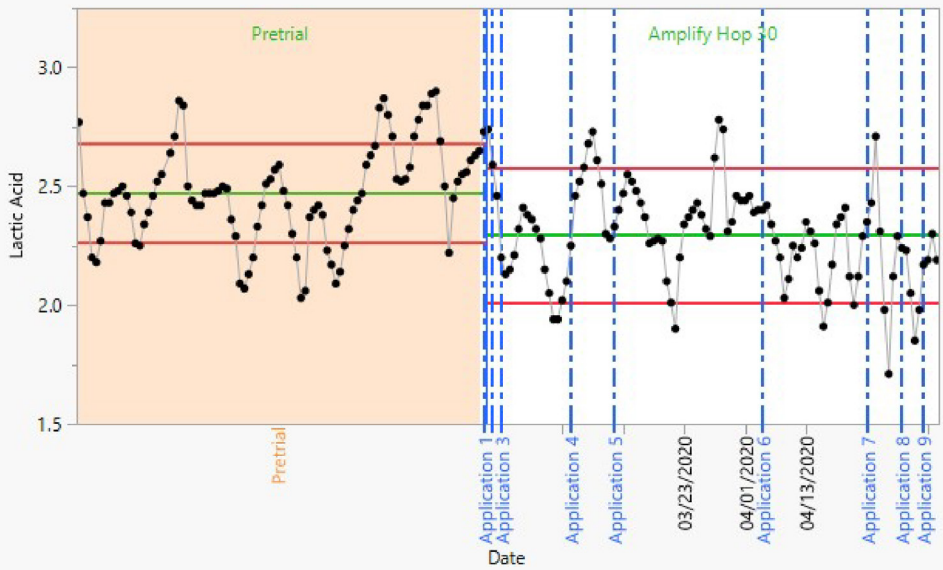
Levels not connected by same letter are significantly different.

Missing Rows	1
Excluded Rows	3

Similar LAB trends were observed throughout the fermentation train. Chart 3 below illustrates the LAB trends in Ferm 4 which is following a similar trend as observed in the preferm. Chart 4 below is the statistical analysis comparing the means for LAB in Ferm 4 for the two different treatment phases. Again, the Amplify Hop 30 treatment resulted in significantly lower LAB than the LAB during the pretrial data set.

Chart 3: Ferm 4 LAB Control Chart

Control Chart | Individual Measurement Of Lactic Acid

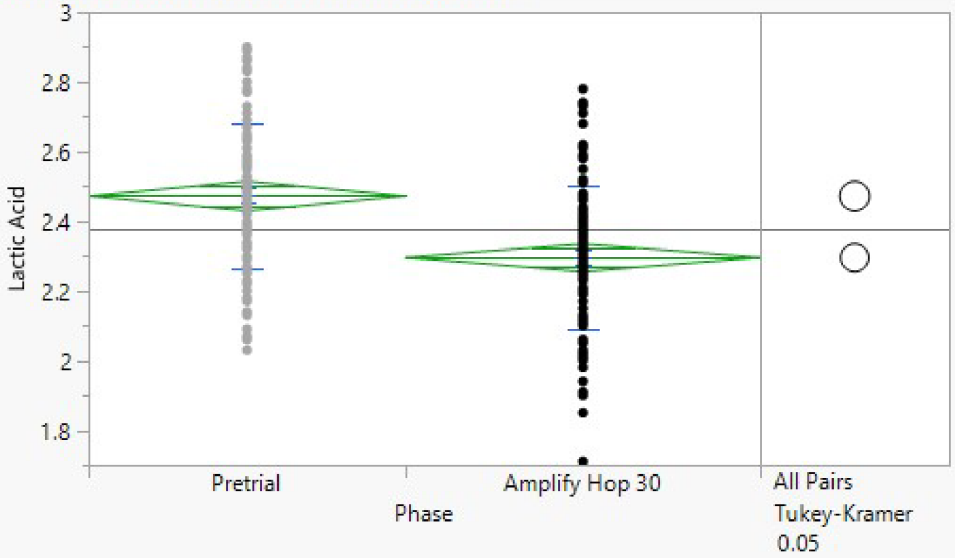


Phase Limits

Phase	LCL	Avg	UCL
Pretrial	2.263287	2.471935	2.680584
Amplify Hop 30	2.013159	2.295288	2.577418

Chart 4: Ferm 4 LAB vs. Treatment Phase

Oneway Analysis of Lactic Acid By Phase



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pretrial	93	2.4719355	0.2083906	0.0216091	2.4290179	2.514853
Amplify Hop 30	104	2.2952885	0.2066795	0.0202666	2.2550945	2.3354825

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Confidence Quantile

q*	Alpha
1.97220	0.05

HSD Threshold Matrix

Abs(Dif)-HSD

	Pretrial	Amplify Hop 30
Pretrial	-0.06001	0.11825
Amplify Hop 30	0.11825	-0.05675

Positive values show pairs of means that are significantly different.

Connecting Letters Report

Level			Mean
Pretrial	A		2.4719355
Amplify Hop 30		B	2.2952885

Levels not connected by same letter are significantly different.

Missing Rows 1

Chart 5: LAB Delta Control Chart

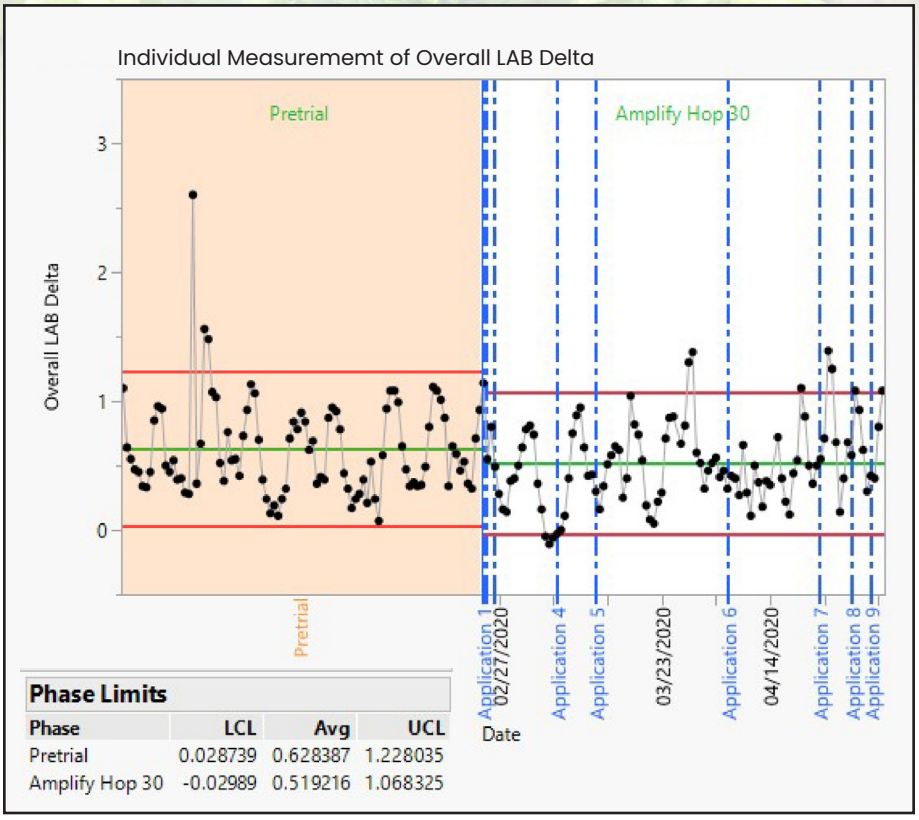
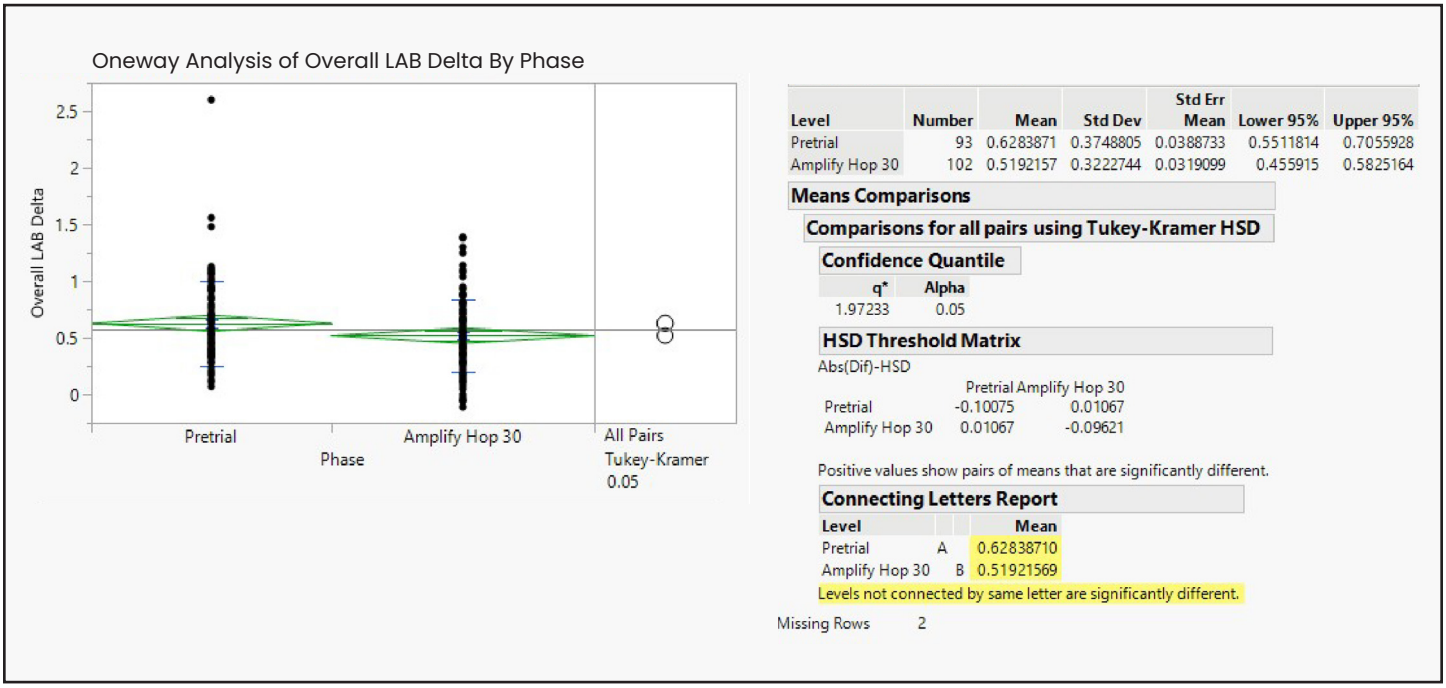


Chart 5 depicts the Delta LAB. This is the LAB generated throughout the fermentation train from Preferm to Beerwell. The blue dashed lines below again indicate the dates that Amplify Hop 30 was applied. During the Amplify Hop 30 usage, the Delta LAB is lower on average than during the pretrial data set. Chart 6 illustrates the statistical analysis comparing the two means indicating that the lower Delta LAB seen during Amplify Hop 30 usage is significantly lower than the Delta LAB during the pretrial time period.

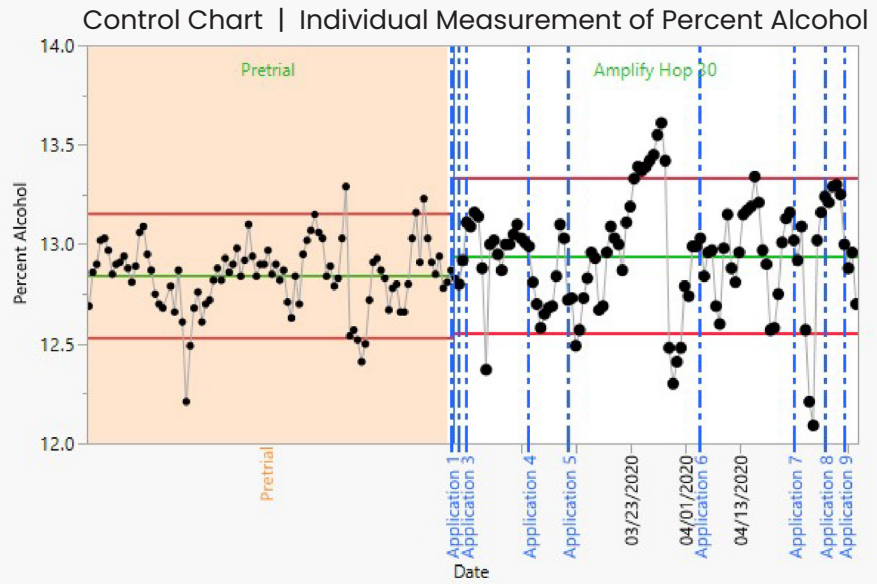
Chart 6: LAB Delta vs. Treatment Phase



Alcohol (Ethanol)

Chart 7 below depicts the historical alcohol (ethanol) trends observed in Ferm 4. Overall trends indicate an increase in alcohol (ethanol) during the period that Amplify Hop 30 was implemented. Chart 8 below indicates that this increase of alcohol (ethanol) seen during Amplify Hop 30 usage is significantly different than the pretrial alcohol (ethanol) average. Analysis of beerwell data indicates a similar trend of higher alcohol (ethanol) levels seen during the period that Amplify Hop 30 was utilized compared to pretrial. These differences between the beerwell averages are not yet significantly different.

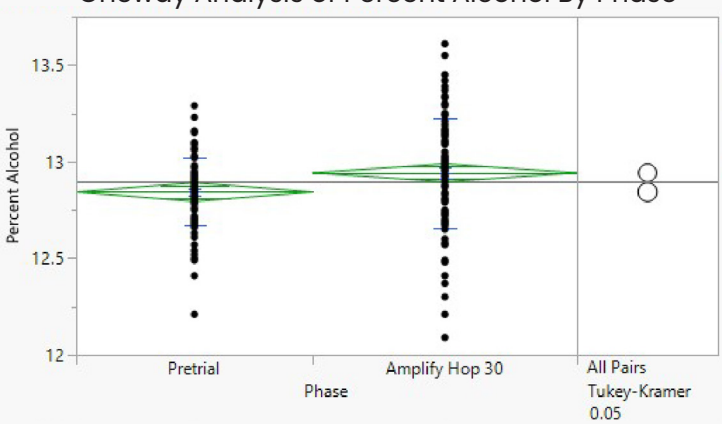
Chart 7: Ferm 4 Alcohol (Ethanol) Control Chart



Phase Limits

Phase	LCL	Avg	UCL
Pretrial	12.53275	12.84312	13.15349
Amplify Hop 30	12.55115	12.94221	13.33327

Chart 8: Ferm 4 Alcohol (Ethanol) vs. Treatment Phase



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pretrial	93	12.843118	0.1755425	0.0182029	12.806966	12.879271
Amplify Hop 30	104	12.942212	0.2849117	0.0279379	12.886803	12.99762

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Confidence Quantile

q*	Alpha
1.97220	0.05

HSD Threshold Matrix

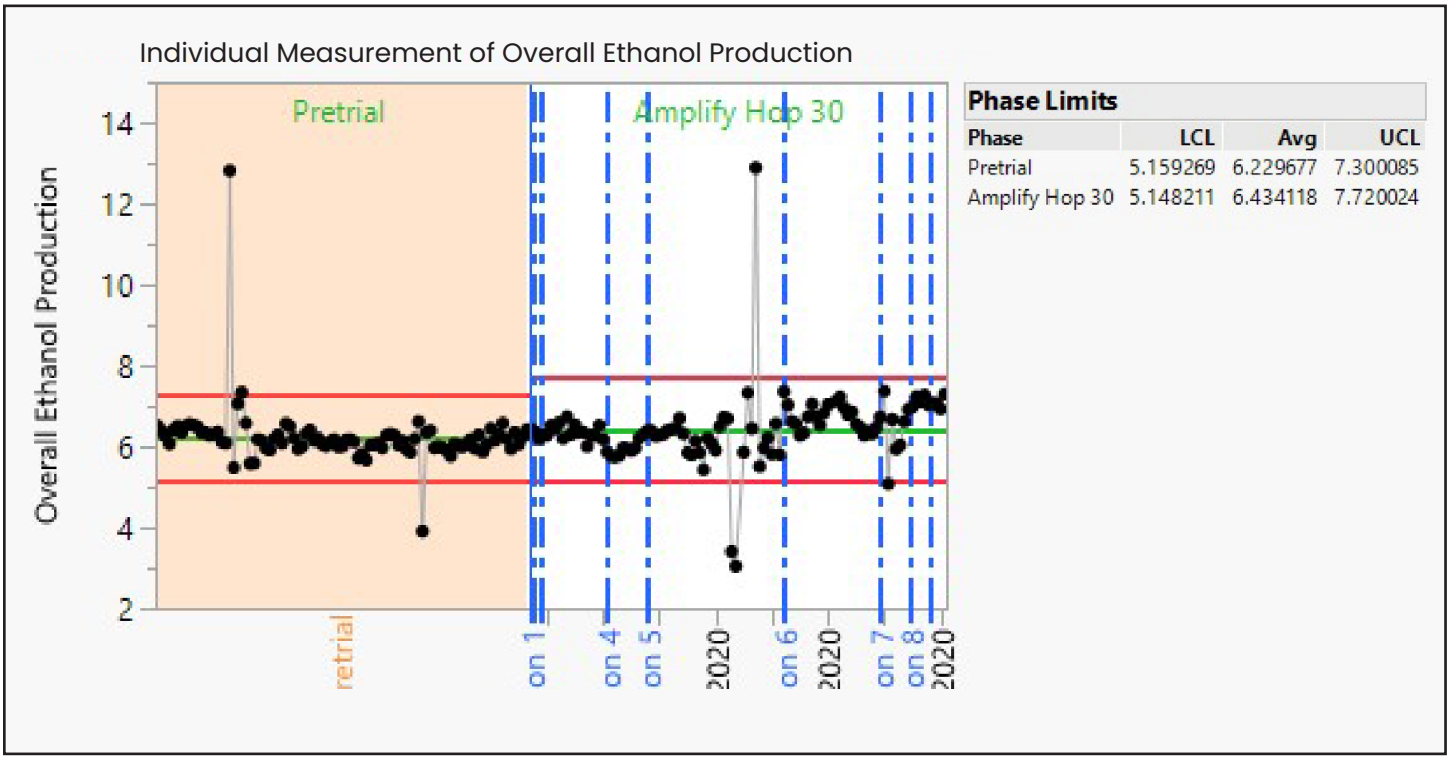
Abs(Dif)-HSD

	Amplify Hop 30	Pretrial
Amplify Hop 30	-0.06553	0.03165
Pretrial	0.03165	-0.06930

Fermentation Kinetics

Chart 9 below illustrates the amount of alcohol (ethanol) produced throughout the fermentation train from the preferm to the beerwell. As the chart indicates, there is a greater amount of alcohol (ethanol) produced during the period that Amplify Hop 30 is being used compared to the pretrial data set. Chart 10 below illustrates the average glucose present in Ferm 4 for both treatment phases. The significantly lower glucose seen in Chart 10 for Ferm 4 during Amplify Hop 30 usage coupled with the higher alcohol (ethanol) seen in Ferm 4 during Amplify Hop 30 usage indicate that overall there is faster fermentation kinetics occurring with Amplify Hop 30 implementation compared to the pretrial data set.

Chart 9: Alcohol (Ethanol) Production Kinetics

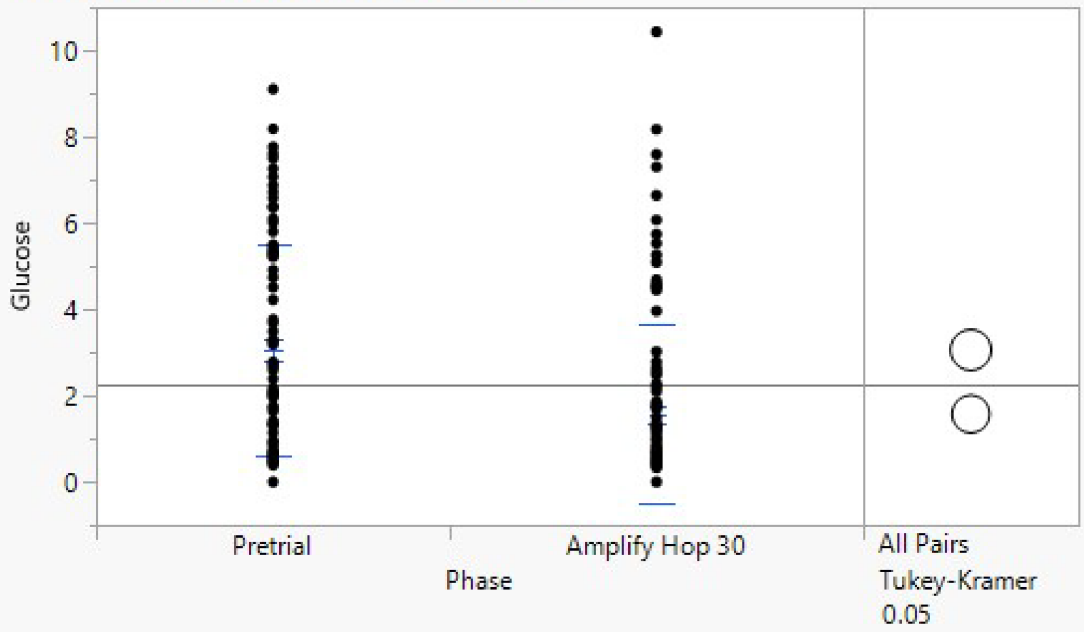


Phase Limits

Phase	LCL	Avg	UCL
Pretrial	5.159269	6.229677	7.300085
Amplify Hop 30	5.148211	6.434118	7.720024

Chart 10: Ferm 4 Glucose vs. Treatment Phase

Oneway Analysis of Glucose By Phase



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 9
Pretrial	89	3.0570787	2.4630779	0.2610857	2.5382256	3.5759
Amplify Hop 30	104	1.5702885	2.0825756	0.2042133	1.1652795	1.9752

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Confidence Quantile

q*	Alpha
1.97246	0.05

HSD Threshold Matrix

Abs(Dif)-HSD

	Pretrial	Amplify Hop 30
Pretrial	-0.66997	0.84143
Amplify Hop 30	0.84143	-0.61978

Positive values show pairs of means that are significantly different.

Connecting Letters Report

Level			Mean
Pretrial	A		3.0570787
Amplify Hop 30		B	1.5702885

Levels not connected by same letter are significantly different.

Missing Rows 5

Glycerol

Glycerol production can be an indication of yeast stress which can correlate to a loss of alcohol (ethanol) production. Charts 11 and 12 below depict the historical glycerol trends seen in the preferm and in Ferm 4 respectively. One can observe that over time, the glycerol is trending down. A statistical analysis of comparing the means for each data set indicate that although the glycerol is on average lower with Amplify Hop 30 usage, it is not yet significantly different compared to the pretrial glycerol averages.

Chart 11: Preferm Glycerol Control Chart

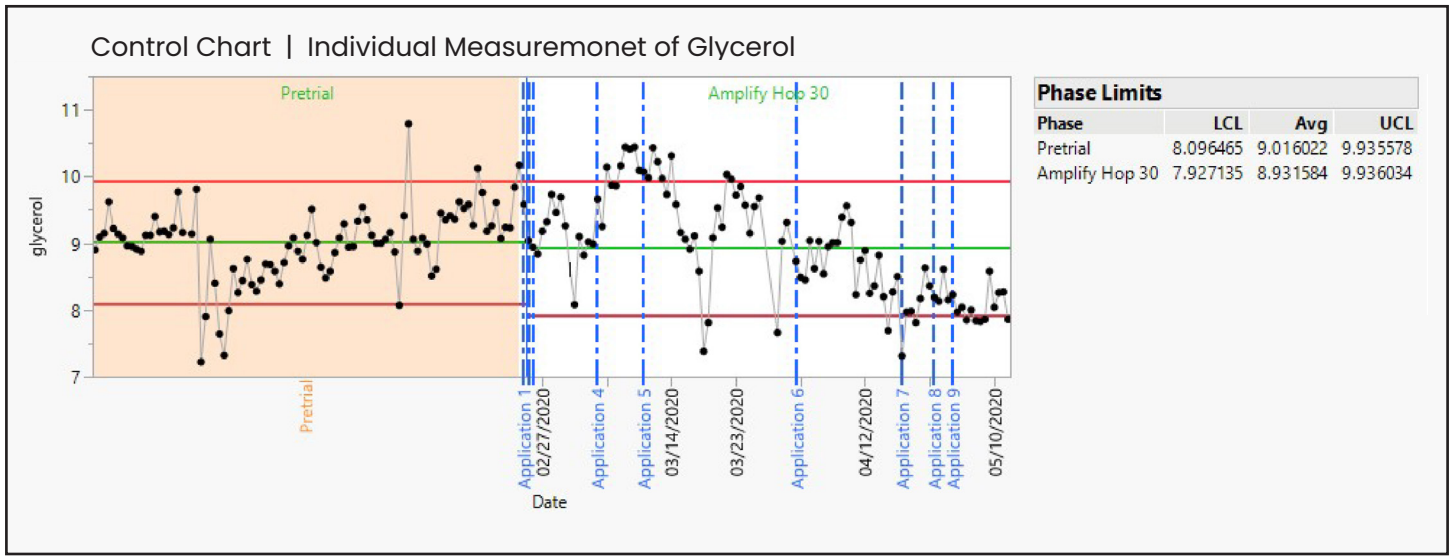
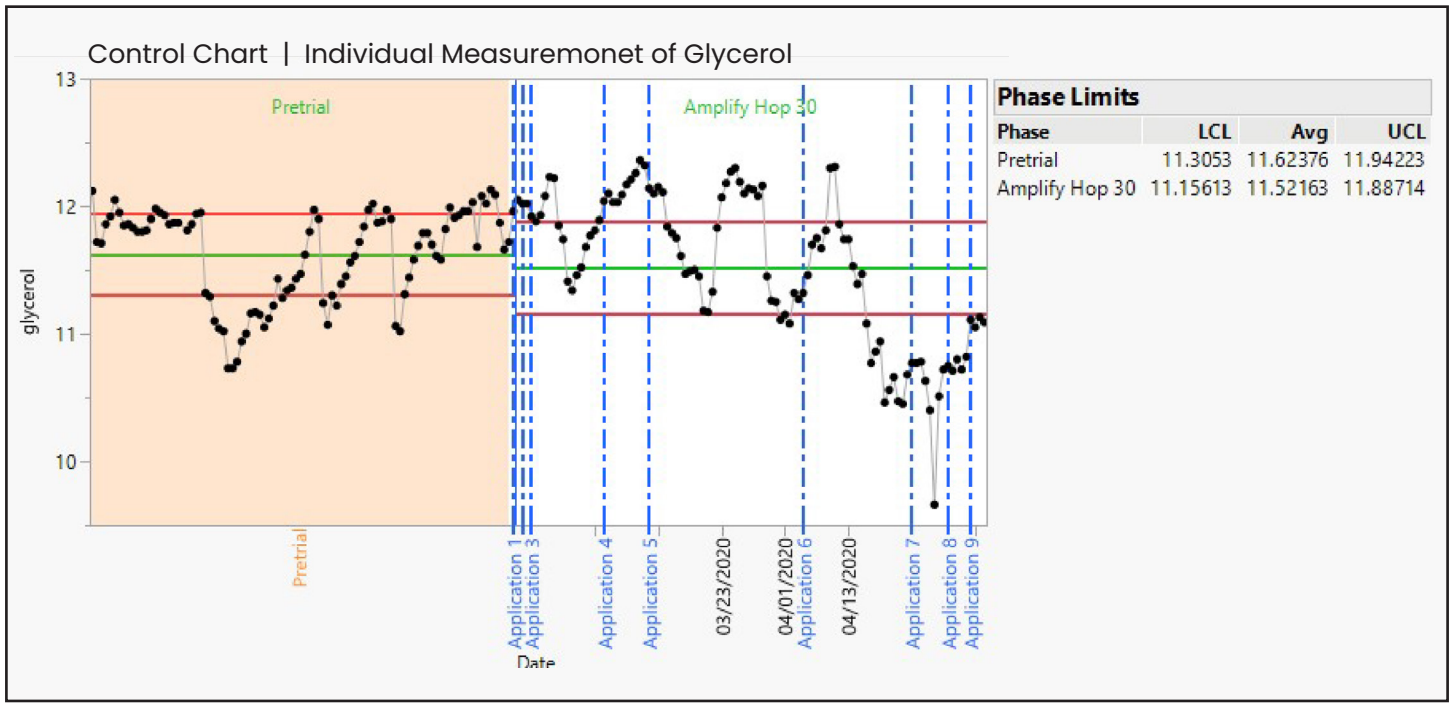


Chart 12: Ferm 4 Glycerol Control Chart



Yeast Health

Chart 13 below illustrates the yeast budding throughout the fermentation train for each treatment phase. During the time that Amplify Hop 30 was utilized, there is slightly higher yeast budding seen compared to pretrial data. Chart 14 below illustrates the yeast counts seen throughout the fermentation train. Again, there is a slight increase in cell counts observed during the time that Amplify Hop 30 is utilized compared to pretrial data.

Chart 13: Yeast Budding vs. Treatment Phase

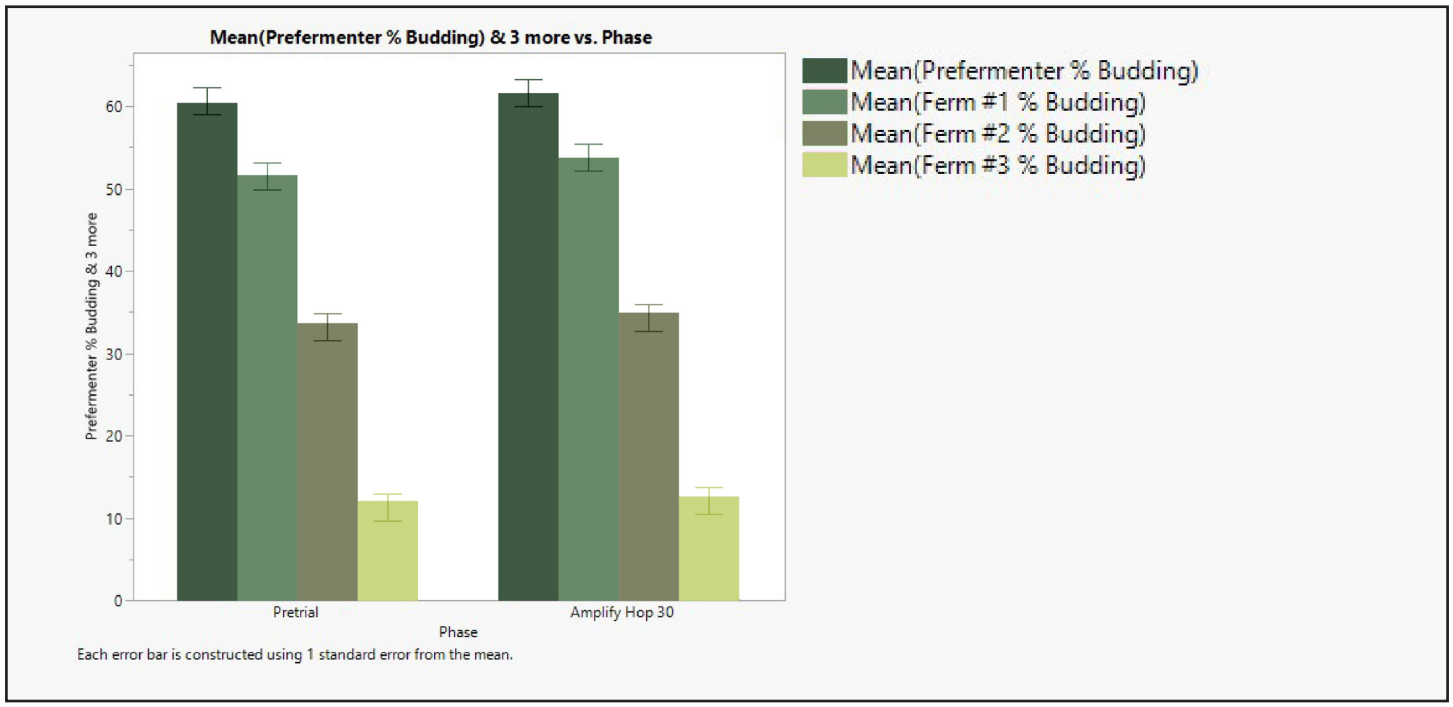
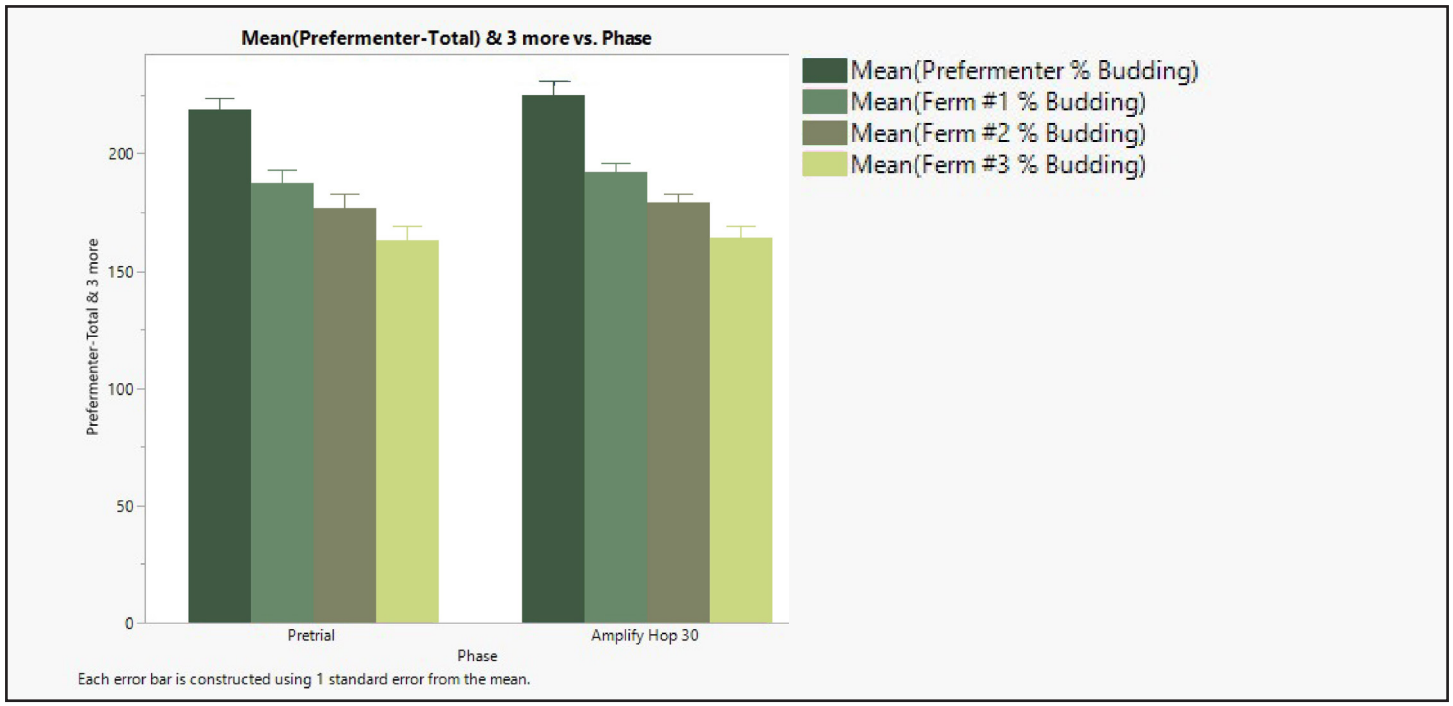


Chart 14: Yeast Count vs. Treatment Phase



Conclusion

Overall, the implementation of Amplify Hop 30 resulted in the following positive impacts:

- Decreased levels of LAB observed throughout entire fermentation train during Amplify Hop 30 usage
- Greater alcohol (ethanol) production observed throughout the fermentation train during Amplify Hop 30 usage
- Faster fermentation kinetics observed during Amplify Hop 30 usage
- Reduced levels of glycerol observed throughout entire fermentation train during Amplify Hop 30 usage
- Improved yeast health observed during Amplify Hop 30 usage

Contact us today to learn how you can use these results to improve your fermentation process.

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