



TECHNICAL BULLETIN

Zemea® USP-FCC Propanediol: Microbiological Shelf Life Study

Introduction

The preservative efficacy of Zemea® USP-FCC propanediol in water additive flavoring systems was studied. The challenge testing was conducted by Silliker Laboratories using standardized microbiology guidelines.

Experimental Design

Formulation

Experimental design was based on several different water additive flavoring systems with Zemea® USP-FCC propanediol used at a final concentration of 25% (v:v) in each formulation. Each formulation contained both ascorbic and citric acid that were adjusted to a pH of 2.0 and the water activity (aw) was 0.7. The tested formulations included:

- Lemon Tea inclusive of 20% tea botanical
- Peach Tea with 20% tea botanical plus peach juice/essence
- Pomegranate Cranberry Tea inclusive of a high saccharide natural vegetable colorant
- Apple Tea flavor inclusive of apple fruit juice and aqueous apple essence

Test Methods & Organisms

The challenge testing was conducted by Silliker Laboratories. The formulation variants were injected with the microorganisms as follows, under ambient (73-77°F) storage conditions, without a further processed “kill step”. Initial samples were analyzed within 15 minutes after inoculation. In addition, uninoculated yeast and mold testing was run concurrently with testing hurdles at three weeks and four weeks.

Microorganism	Initial inoculum level
<i>E. coli</i> O157:H7	6.30
<i>Salmonella</i> spp.	6.20
<i>L. monocytogenes</i>	6.30
Yeast	3.71
Mold	3.84

Table 1. Microorganisms tested and initial inoculum levels that were used in the study.

Results

- In all variants the death of the microorganisms occurred within the first 24 hours. These products also remained stable for the first milestone of three weeks and a final milestone of four weeks.
- Uninoculated yeast and mold was run concurrently with the microorganism testing. Zemea® USP-FCC propanediol did not support any yeast or mold growth, a secondary benefit to Zemea® USP-FCC propanediol ability to deter bacterial and fungal growth.
- Despite the introduction of nutritive substances, fruit and vegetable juices and other nutritive botanical matter, the systems inclusive of Zemea® USP-FCC propanediol did not support microbiological growth.

Conclusion

- Zemea® USP-FCC propanediol is a pure, naturally derived ingredient providing antimicrobial and antifungal properties.
- Zemea® USP-FCC propanediol offers bitterness suppression in food and beverages, as well as a welcome alternative to petroleum-based flavor and extract carriers.
- Zemea® USP-FCC propanediol is ideally suited for both food and beverage applications. It functions well as a carrier, extraction solvent, taste modifier, diluent, and humectant.

Data Summary

Tables 2-5 summarize the microbiological counts (Log10 CFU/g*) of the 4 different fruit flavored tea water additive flavor formulations when inoculated with *E.coli*, *Salmonella* spp. and *L. monocytogenes*:

		Table 2. Lemon Tea			Table 3. Pomegranate Cranberry Tea		
Pull Time	Replicate	<i>E. coli</i> O157:H7	<i>Salmonella</i> spp.	<i>L. monocytogenes</i>	<i>E. coli</i> O157:H7	<i>Salmonella</i> spp.	<i>L. monocytogenes</i>
Day 0	1	6.25	3.34	5.72	5.33	<1.00	4.04
	2	6.21	3.38	5.67	5.20	<1.00	3.54
	3	6.23	3.30	5.83	5.75	<1.00	2.81
Day 2	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Day 4	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

		Table 4. Peach Tea			Table 5. Apple Tea		
Pull Time	Replicate	<i>E. coli</i> O157:H7	<i>Salmonella</i> spp.	<i>L. monocytogenes</i>	<i>E. coli</i> O157:H7	<i>Salmonella</i> spp.	<i>L. monocytogenes</i>
Day 0	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Day 2	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Day 4	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

* Log10 CFU/g: logarithm base 10 colony forming unit per gram

Testing was conducted for yeast and mold growth with testing hurdles at both three weeks and four weeks for each variant in each category. Tables 6-8 summarize the microbiological counts (Log10 CFU/g*) of the yeast and mold inoculated fruit flavored tea flavor formulations.

		Table 6. Lemon Tea		Table 7. Pomegranate Cranberry Tea		Table 8. Peach Tea	
Pull Time	Replicate	Yeast	Mold	Yeast	Mold	Yeast	Mold
Day 0	1	3.26	3.28	3.45	3.41	<1.00	3.08
	2	3.45	3.30	3.57	3.36	<1.00	3.08
	3	3.45	3.40	3.50	3.46	<1.00	2.95
Week 1	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 2	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 3	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 4	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

* Log10 CFU/g: logarithm base 10 colony forming unit per gram

Additional testing was conducted for aerobic bacteria, yeast and mold growth with testing hurdles at both three weeks and four weeks for each variant in each category. Tables 9-12 summarize the microbiological counts (Log10 CFU/g*) of the uninoculated fruit flavored tea flavor formulations.

		Table 9. Lemon Tea			Table 10. Pomegranate Cranberry Tea		
Pull Time	Replicate	Aerobic Bacteria	Yeast	Mold	Aerobic Bacteria	Yeast	Mold
Day 0	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 1	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 2	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 3	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 4	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

		Table 11. Peach Tea			Table 12. Apple Tea		
Pull Time	Replicate	Aerobic Bacteria	Yeast	Mold	Aerobic Bacteria	Yeast	Mold
Day 0	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 1	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 2	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 3	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Week 4	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

* Log10 CFU/g: logarithm base 10 colony forming unit per gram

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