



IN PARTNERSHIP WITH
calexo

CASE STUDY

PULP & SEDIMENTATION: MITIGATING CHALLENGES IN INFUSED BEVERAGES



Images of Citrus Rose
Cannabis-Infused
beverage from Calexo

INTRODUCTION

Ready-to-drink beverages come in all shapes, sizes, and flavors. Some beverage types, most commonly juices and teas, include pulp or other sediments.

In working with a wide variety of product developers, Vertosa observed a unique trend for cannabis-infused beverages containing sedimentation:

the majority of sediment-rich beverages have challenges with potency consistency.

As such, Vertosa set out to prove the hypothesis that sedimentation was to blame for failed and inconsistent potency, and to identify a way for beverages with heavy sedimentation to maintain consistent potency levels once infused.

PULP & SEDIMENTATION CAN BE A CHALLENGE FOR INFUSED BEVERAGES

CALEXO

The founders of Calexo set out to produce a light, refreshing alcohol alternative beverage infused with cannabis. Before engaging with Vertosa, Calexo trialed a few different emulsion providers and experienced inconsistencies in their potency testing, and couldn't figure out why.



Calexo's
Cucumber
Citron



Kombucha
Natural
Sediment

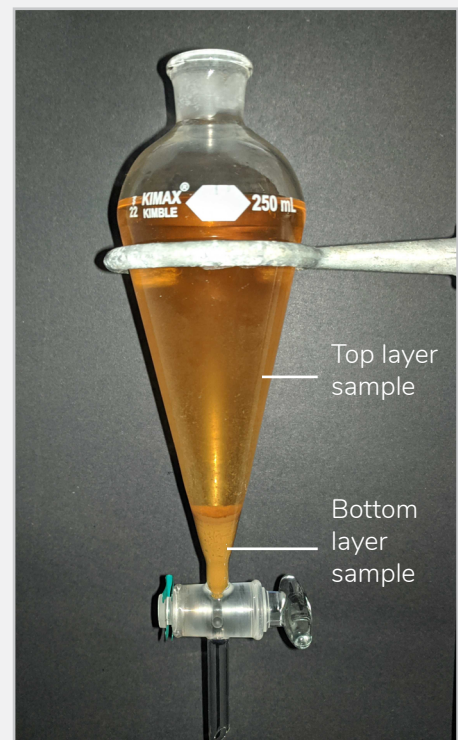
KOMBUCHA BRAND

A leading kombucha manufacturer wanted to expand their product offering to include cannabinoids. As unfiltered kombucha contains heavy sedimentation, they understood the associated manufacturing and processing challenges and utilized Vertosa to help come up with solutions.

CONFIRMATION OF SEDIMENTATION AS THE PROBLEM

Vertosa hypothesized that pulp and sedimentation caused potency inconsistency, and in order to prove the concept Vertosa performed the following analysis:

1. Infuse various emulsion types into Kombucha Tea base and both Calexo flavors
2. Pour infused samples into separation funnel and let it sit for 24 hours
3. Collect material from the top and bottom layers of all samples, and test for potency
4. Compare potency levels between the top layer (minimal sedimentation) and the bottom layer (heavy sedimentation) of test subjects to control sample (water)



RESULTS FROM SEPARATION FUNNEL EXPERIMENT

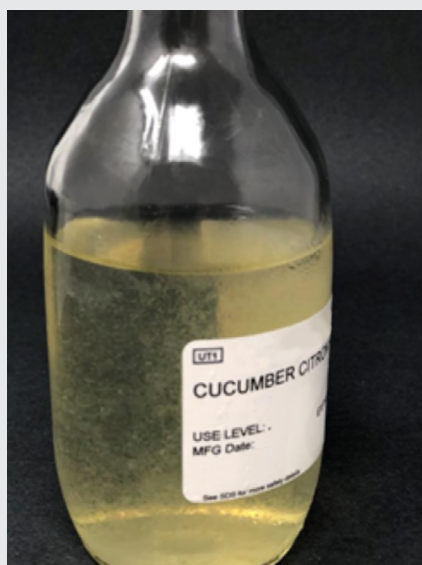
Based on the results in Table 1 below, it was evident the hypothesis was correct.

Sedimentation appears to bind with emulsion droplets and drag them down as the sediment settles, creating

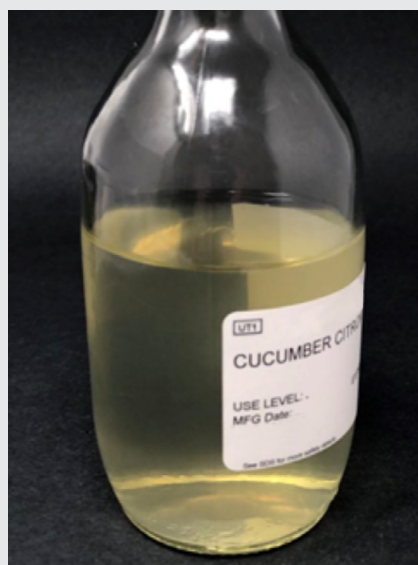
concentrated potency at the bottom relative to upper layers. This is reflected in the chart below: when the bottom/top ratio is not 1, there is a homogeneity issue. This phenomenon occurs across all emulsion types.

TABLE 1. POTENCY DISCREPANCY RESULT FROM BASES WITH PULP AND SEDIMENTATION

Product Base	Emulsion Formula	Target Potency (mg/g)	Bottom Layer Potency (mg/g)	Top Layer Potency (mg/g)	Bottom / Top Ratio
Water (Control)	N1	0.025	0.024	0.024	1
Kombucha	N1	0.053	0.113	0.012	9.4
Kombucha	O1	0.053	0.104	0.037	2.8
Kombucha	O2	0.053	0.15	0.036	4.3
Calexo	N1	0.0154	0.016	0.009	1.7



Pre filtration



Post filtration

Pre and post filtration
of Calexo Cucumber
Citron base

SOLUTION 1: PULP FILTERING

As mentioned, Calexo was targeting a light, refreshing profile for their beverage, so removing the pulp from the base was considered as a possible solution to their potency issues.

After filtering the pulp from Calexo's base formulas, Vertosa infused and re-performed the separation study.

Data indicates that after removing the pulp, the bottom/top potency ratio was 1, indicating a highly uniform potency distribution.

Base	Target (mg/g)	Top Layer (mg/g)	Bottom Layer (mg/g)	Bottom / Top Ratio
Cucumber Citron	0.0154	0.014	0.014	1.00
Citrus Rose		0.014	0.014	1.00
Cucumber Citron (unfiltered)		0.009	0.016	1.78
Citrus Rose (unfiltered)		0.015	0.026	1.73

SOLUTION 2: MANUFACTURING ADJUSTMENTS

For certain products, sedimentation is an important characteristic of a beverage. The yeast sedimentation in kombucha is known to have beneficial probiotics, and Vertosa's kombucha brand partner was unwilling to sacrifice this major attribute of their product.

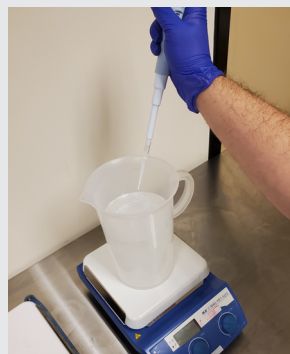
Committed to solving the issue, and with no possibility of filtering the sedimentation

prior to infusion, Vertosa designed a systematic solution that involves adjustments to both the manufacturing and lab testing processes.

1. Manufacturers must ensure an equal amount of sedimentation is dispensed into each individual unit.
2. Testing labs must follow a specific sample preparation method to accurately detect overall potency of an infused product with heavy sedimentation.



Pour 3 bottles together.
Infuse O1 emulsion.



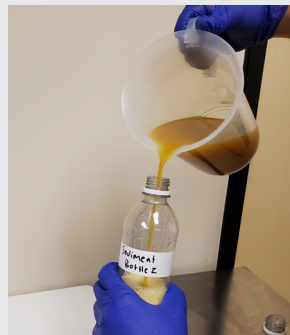
Infuse control water
sample.



Stir both for 20 mins
on day 1.



Let both sit overnight for
sedimentation to settle.



Stir batch immediately
prior to dispensing into
individual units.



Send each sample unit
and control unit (water)
for potency testing.

Once the correct process is used at the manufacturer, it is then imperative that any third party testing lab utilizes the following method for testing:

- 1. Shake the bottle to dislodge any sediment
- 2. Pour out into beaker
- 3. Stir on hot plate for 5 mins
- 4. Take a portion of the sample while stirring

- 5. Dissolve the sample in Methanol
- 6. Centrifuge the sample
- 7. Take the upper clear layer for HPLC analysis

The following chart illustrates the potency results for the kombucha samples after the updated manufacturing and testing methods were utilized:

	Water Control Sample	Kombucha Sample 1	Kombucha Sample 2	Kombucha Sample 3
Potency	0.041	0.043	0.042	0.043
% Difference from water		4.9%	2.4%	4.9%

THE RESULTS ABOVE INDICATE EVEN POTENCY DISTRIBUTION AFTER THE NEW MANUFACTURING AND TESTING METHODS ARE APPLIED.

KOMBUCHA WITH HEAVY SEDIMENTATION COULD NOW BE INFUSED WITH CONSISTENT AND HOMOGENOUS POTENCY.

CONCLUSION

At the end of the study, Vertosa was able to confirm that any pulp or sedimentation within a infused product will affect potency homogeneity.

Vertosa developed two options to ensure homogenous potency in an infused beverage, depending on the developer's preference:

1. Removing the sedimentation through filtration is the simplest solution for infused beverages, and this allowed Calexo to launch their infused beverages with no ongoing concern.
2. Vertosa developed methods to achieve potency homogeneity for products that contain sedimentation and will not be filtered, such as kombucha. These steps involve close collaboration with co-manufacturers and testing labs.



Images of Cucumber
Citron Cannabis-
Infused beverages
from Calexo



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Disclaimer: This is a representative study designed with specific consideration for the unique ingredients, processing methods, packaging, co-manufacturer, and emulsion types. All of these variables must be considered on an individual product basis and Vertosa makes no claims otherwise. Please consult with a Vertosa representative to design a system that achieves your specific goals.