Formulating Protein Beverages
Real World Challenges & Tactical Solutions

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Topics

Let’s Review the Basics

Formulation & Processing Considerations

Case Studies
Let’s Review the Basics...
Amino Acids
Building blocks of protein

- Amino acids found in nature
- Indispensable to human nutrition
- Important to muscle recovery
Basic Amino Acid Structure
Amino Acid Side Chains

Non-polar

Polar

Electrically Charged

Acidic
Aspartic Acid (Asp)  Glutamic Acid (Glu)

Basic
Lysine (Lys)  Arginine (Arg)  Histidine (His)
Peptide Bond
Protein Structures

Amino acids

Primary Structure

Secondary Structure

Tertiary Structure
Protein Isoelectric Points

$pH = 6.6$

H$^+$

$pH = 4.6-4.7$

H$^+$

$pH = 1.0$

OH$^-$

$pH = 6.6$

$pH = 14.0$
**Summary**

- Protein is built from a complex and highly organized set of molecules.
- Different protein sources will have different properties depending on the amino acid profile. This includes the final structure and functionality of the protein in nature.
- These properties can be harnessed when developing beverages (i.e. building viscosity or creating emulsions).
- These properties can also be detrimental to the product (i.e. sedimentation, gritty mouth feel).
Formulation & Processing Considerations
Formulation Considerations

Protein Level & Source

Protein Stabilization

Carbohydrate Level & Source

Fat Content

Vitamin, Mineral and Salt Content

Juice Claims (pH)

Whole Grain, Fiber and Other Ingredients
Processing Considerations

Order of Ingredient Addition
pH adjustment
Homogenization

Importance of Protein Hydration
Thermal Processing
Cooling
Filling
Case Studies
**Case Study #1: Nutritional Shake**

- 3-4% Protein
- Neutral pH (6.6-7.0)
- Low carbs/sugar
- Low fat
- Contains vitamins and minerals
- May also contain other solids like Cocoa, Fiber, Whole Grain, etc.
- Total Solids <12%
Case Study #1: Nutritional Shake

- Creating pre-blends of powders
- Fractioning water during production
- Scaling from pilot plant to production when using stabilizing gums
Case Study #2: Nutritional Shake w/ High Total Solids

- 10-14% Protein
- High amount of carbs
- High amount of fat
- >25% Total Solids
- Same rules apply as Case Study #1, but now focusing on HIGH SOLIDS.
- Interactions with proteins are more likely with less water available.
Case Study #2: Nutritional Shake w/ High Total Solids

Thermal Processing:
• Indirect vs. Direct Steam

Homogenization:
• Upstream vs. Downstream
Case Study # 2: Nutritional Shake w/ High Total Solids

- Substitution of Ingredients
- Adjusting pH
Case Study #3: Clear Protein Beverages

- <5% Protein
- Whey Protein Isolate
- Transparent
- High Acid (pH <3.5)
- Usually contain minimal ingredients to avoid clouding.
Case Study #3: Clear Protein Beverages

- Whey Protein Isolate (WPI)
- How to ensure a clear product
- Maintaining low viscosity
- Beverage stability
My Recommendations

1. Understand the plant processing capabilities BEFORE starting development.

2. Temporary effects of thermal processing on beverage flavor and the need to let the product “mellow”.

3. Refrain from making formulation and/or processing changes until you have evaluated samples that have properly aged.

4. ANY formulation changes should be tested at the pilot scale and validated before scaling to full production.
5. Don't be afraid to call suppliers for information on ingredients they are selling. They will know the most about their ingredient and can help point you in the right direction.

6. Complete shelf life studies!

7. When transferring information to production facilities and providing guidance, make sure you are speaking the same language!

8. Attend the first run! Physically being at the plant can reveal things that you may have forget to address remotely or over the phone.
References


Thank You!

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