

# Great Expectations of Food Proteins: Can Soy Proteins measure up?

**Minhthy Nguyen, Ph.D.**

*“Unlocking the Value of Soy Protein in Consumer Foods”* Symposium  
October 18<sup>th</sup>, 2007, Ontario, Canada



Innovation through Nature.

# Consumers Perceive Soy as “Healthy”\*

- **74% of consumers perceive soy products as “healthy”.**
  - **39% (unaided) are aware of specific health benefits.**
  - **17% (unaided) specifically recognize obesity prevention/weight loss as one of those benefits.**
- **60% of consumers agree that consuming soy-based foods can play a role in reducing obesity.**

*\*USB, Consumer Attitudes About Nutrition, 2004-05 National Report*

# Protein in Formulated Food Products: Expectations and Perceptions.

- **Nutrition:** Proteins in foods are expected to be from a high quality source.
  - *Soy is “healthy” but is it a quality source of protein?*
- **Functionality:** Proteins should contribute positively to the final product’s overall physical characteristics.
  - *Soy is a high-quality source of proteins but are these ingredients formulation-friendly in terms of emulsion, solubility, and viscosity?*

# Protein in Formulated Food Products: Expectations and Perceptions.

- **Sensory:** Protein ingredients should contribute positively to the final product overall flavor profile.
  - *Soy is a high-quality and functional source of proteins but will soy-containing products taste good?*
- **Regulatory & Market Positioning:** Proteins should contribute favorably to the marketability of the final product on the shelves.
  - *Soy protein ingredients are versatile in food applications but are they consumer-friendly in terms of allergy, GM, and reasons-to-believe?*

# Nutrition

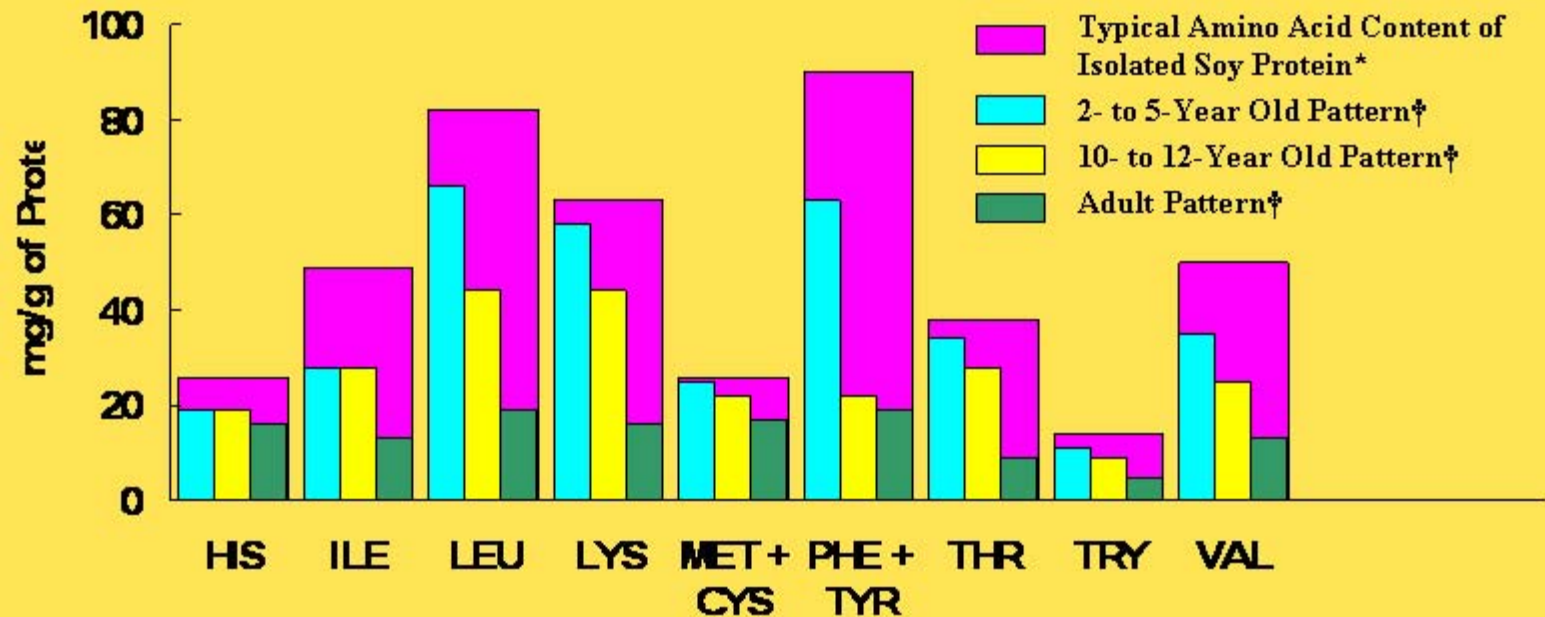
- **Proteins in foods are expected to be from a high quality source.**
  - *Soy is “healthy” but is it a quality source of protein?*

# Nutrition and Protein Quality:

- **Early perception of soy's nutritional quality is shaped by the use of the Protein Efficiency Ratio (PER) method, developed in 1919, to evaluate protein quality.**
  - **Rat require 50% more methionine than humans.**
- **Likewise, this misconception was reinforced during WWII, as soy was used as a low-cost filler – replacing “better” protein sources like milk and meat proteins.**



# Essential Amino Acid Requirement Patterns (FAO/WHO/UNU)



HIS = Histidine; ILE = Isoleucine; LEU = Leucine; LYS = Lysine; MET + CYS = Methionine + Cystine; PHE + TYR = Phenylalanine + Tyrosine; THR = Threonine; TRY = Tryptophan; VAL = Valine

\* Amino acid values for isolated soy protein based on analysis of SUPRO® Brand Isolated Soy Protein provided by Protein Technologies International.

† Suggested pattern of requirements from *Energy and Protein Requirements, Report of the Joint FAO/WHO/UNU Expert Consultation*. Technical Report Series No. 724, 1985.

# **PDCAAS: Protein Digestibility-Corrected Amino Acid Score**

- **Factors used in calculating PDCAAS include –**
  - **Essential amino acid content of food protein.**
  - **Digestibility.**
  - **Ability to supply essential amino acids in amounts adequate to meet human needs.**
- **Uses amino acid requirements of 2- to 5-year old child – most demanding requirements in any group except infants.**
- **Highest possible score is 1.0.**

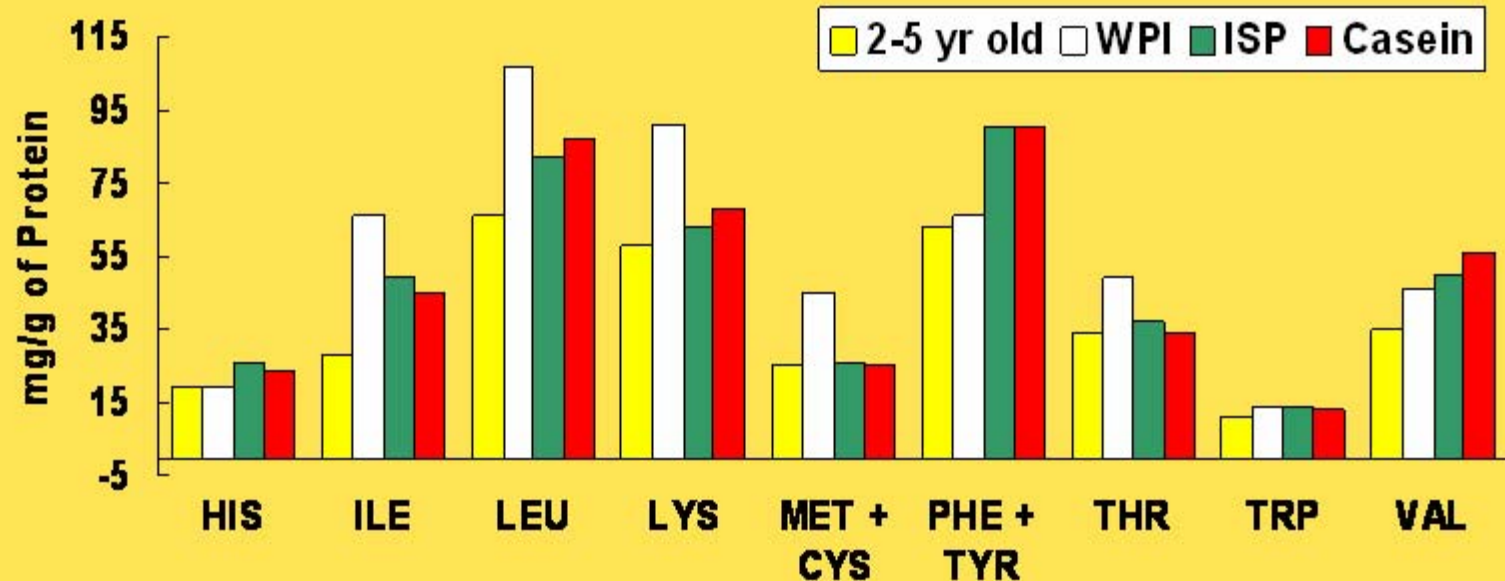


# PDCAAS: Protein Digestibility-Corrected Amino Acid Score

Product	PDCAAS
Isolated Soy Protein*	1.00
Casein	1.00
Egg White	1.00
Skim Milk Powder	1.00
Whey Protein Concentrate	1.00
Beef Protein	0.92
Pea Flour	0.69
Kidney Beans (Canned)	0.68
Pinto Beans (Canned)	0.63
Whole Wheat	0.40
Wheat Gluten	0.25

\* Amino acid values for isolated soy protein based on analysis of SUPRO® Brand Isolated Soy Protein provided by Solae, LLC (Protein Technologies International).

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# **Soy Protein is a High Quality Protein Source**

- **Soy protein meets all the essential amino acid requirements of children.**
- **Soy protein is low in fat.**
- **Soy protein contains no saturated fat.**
- **Soy protein contains no cholesterol.**

# Functionality

- Soy is “healthy” and is a quality source of protein. ✓
- Proteins should contribute positively to the final product’s overall physical characteristics.
  - *Are soy protein ingredients formulation-friendly in terms of emulsion, solubility, and viscosity?*



# Composition of the Soybean

- **40% Protein**



phytic acid  
trypsin inhibitors  
Bowman Birk Inhibitor  
globulins      phenolics

- **15% Mono- & Oligosaccharides**



sucrose, raffinose, stachyose

- **15% Dietary Fiber**



soluble & insoluble fiber

- **20% Oil**



lecithin, sterols, vitamin E

- **10% Other**



moisture, ash

# Whole Soybean Extract

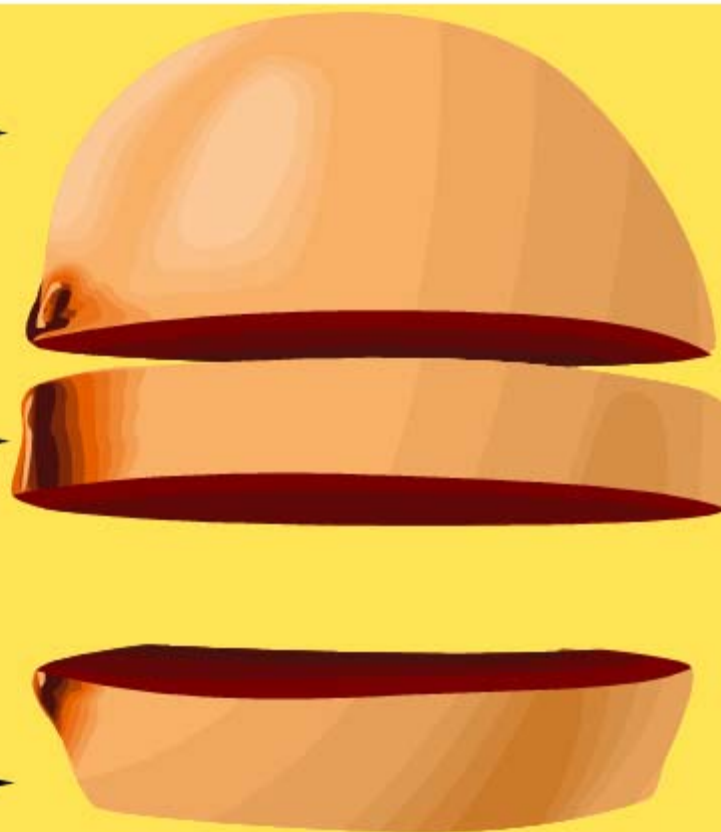
- **Protein**



- **Soluble Carbohydrates**



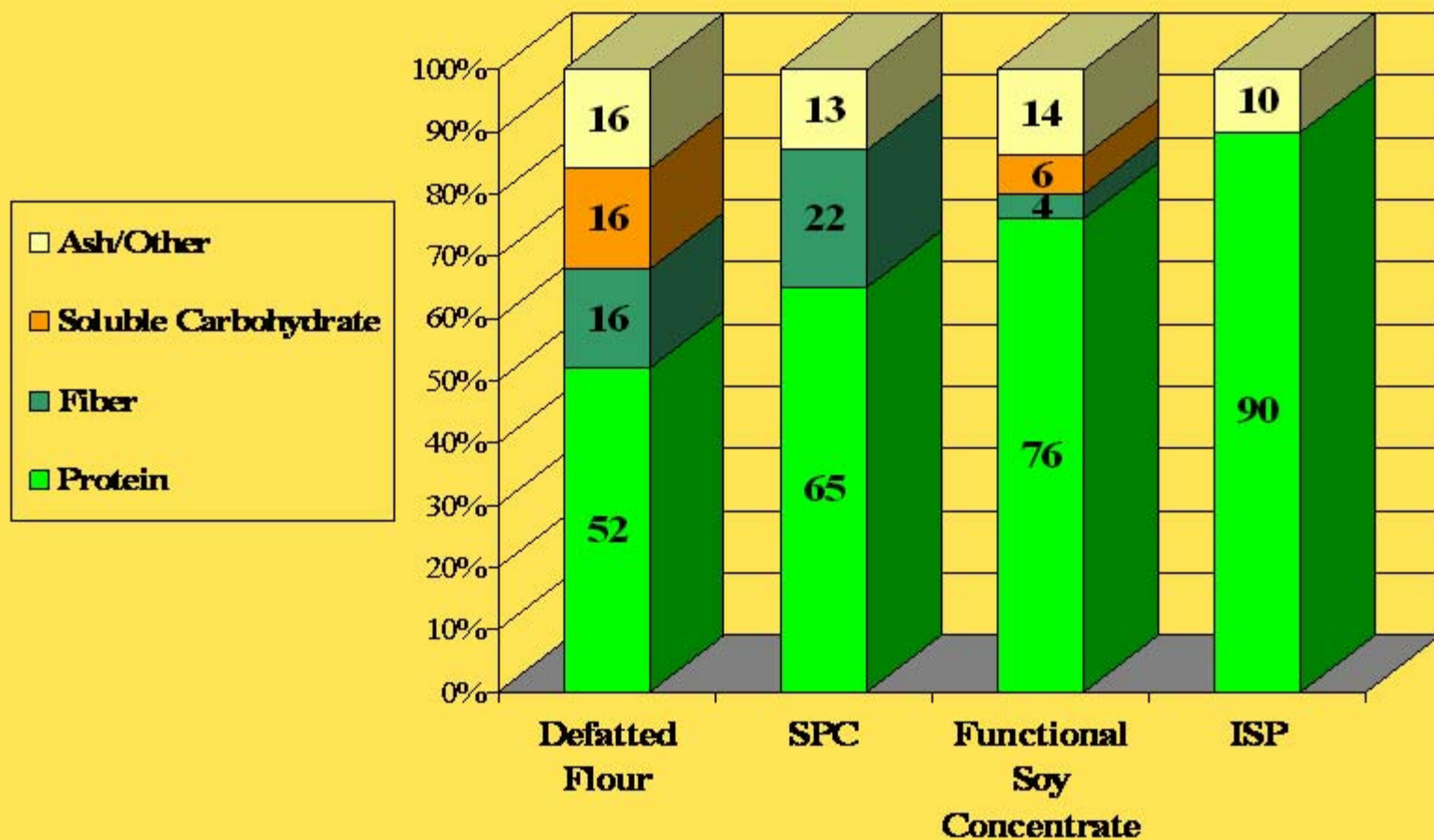
- **Oil**



\* 6.5% protein in liquid product ~ 46% protein ( mfb )



# Composition of Dry Soy Ingredients



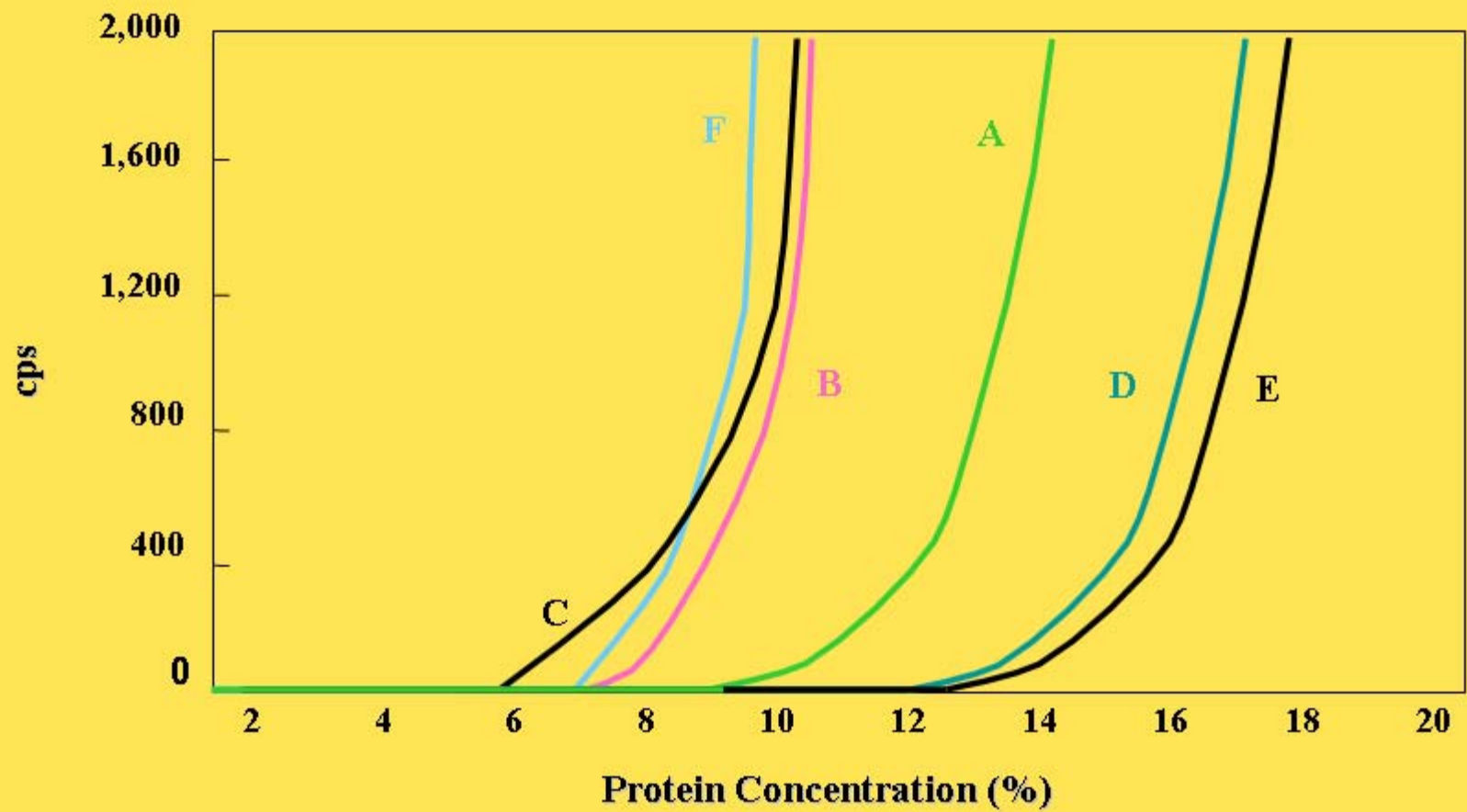
**Soy Proteins are available in a wide variety of product forms.**



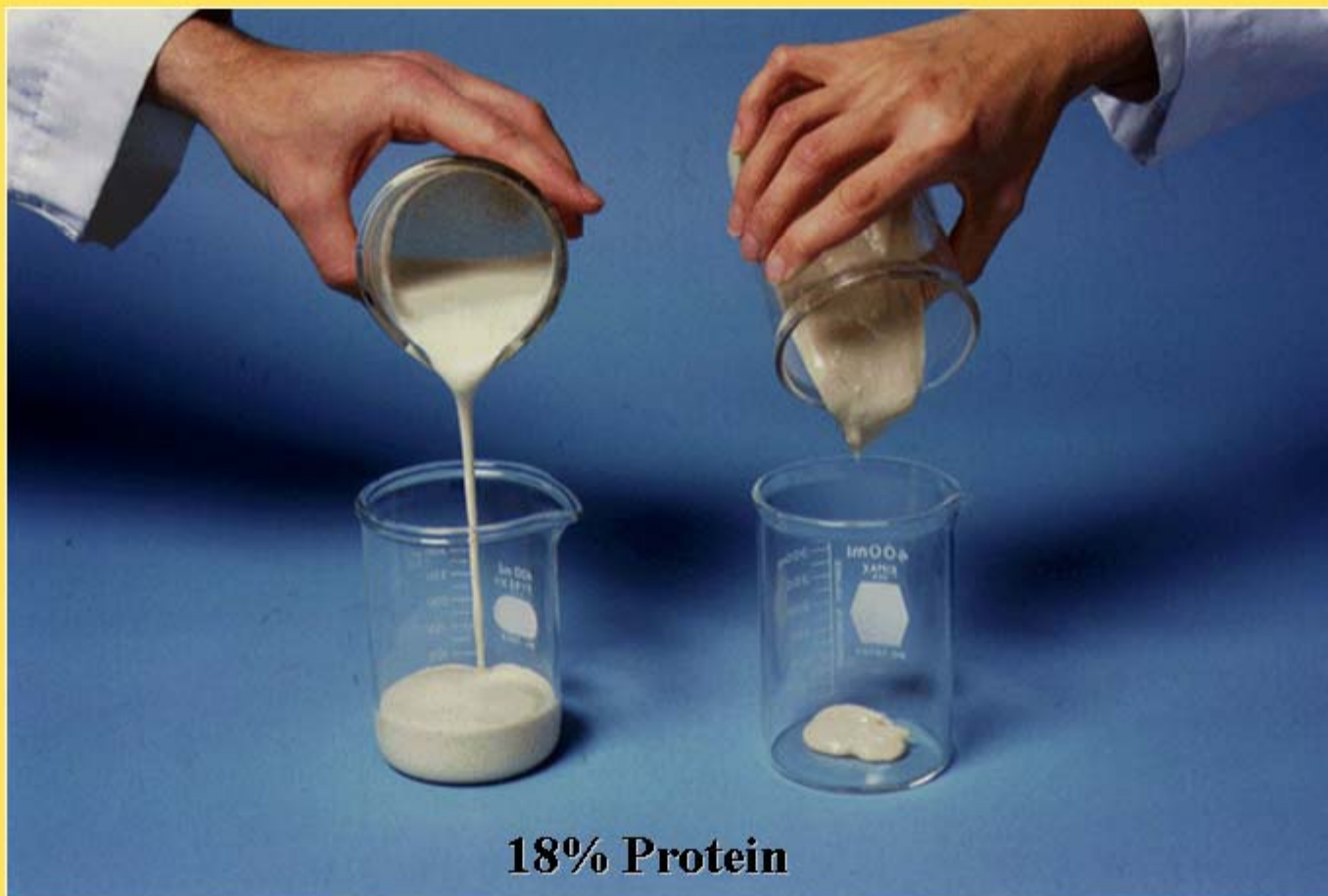
# Functionality

- **Soy protein product offerings are tailored for specific food applications: bars, beverages, frozen desserts, etc.**
- **Functional performance varies across protein products, i.e.:**
  - **Viscosity**
  - **Dispersibility**
  - **Solubility**
  - **Emulsion Capacity**

# Viscosity

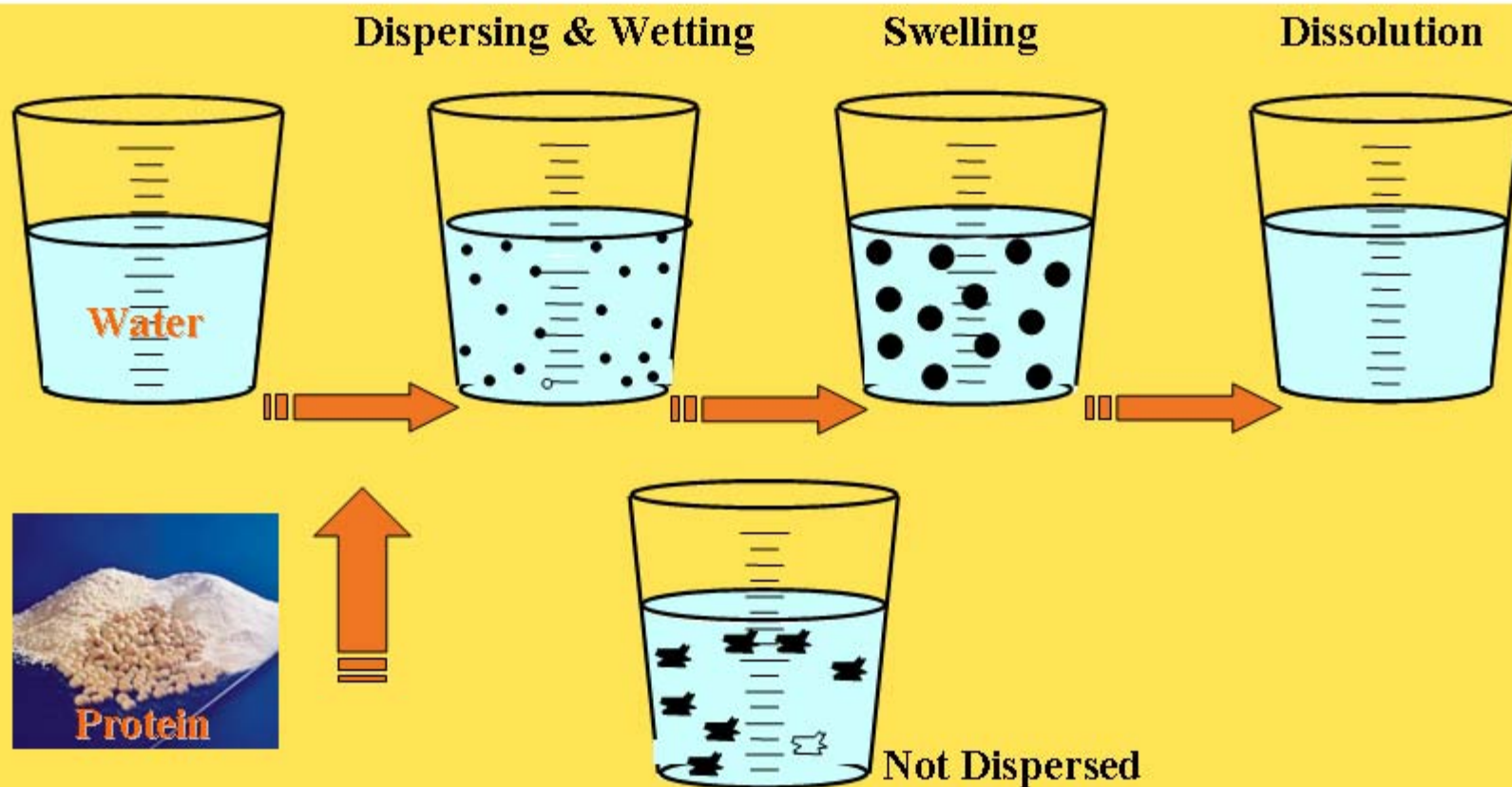


# Viscosity





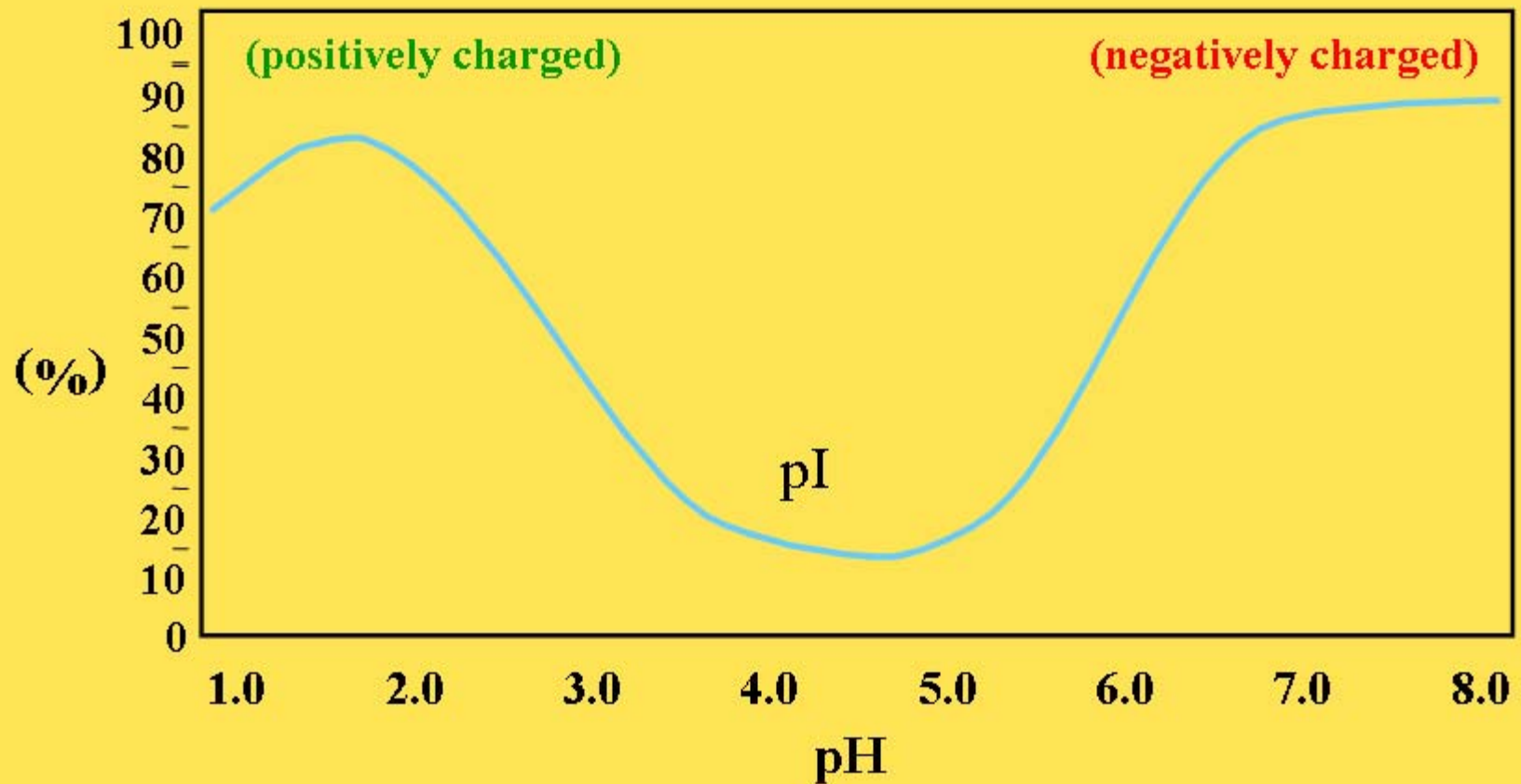
# Dispersibility



*\* Soy proteins will vary in their ability to disperse as well as in the rate at which they disperse.*



# Solubility of ISP as a function of pH

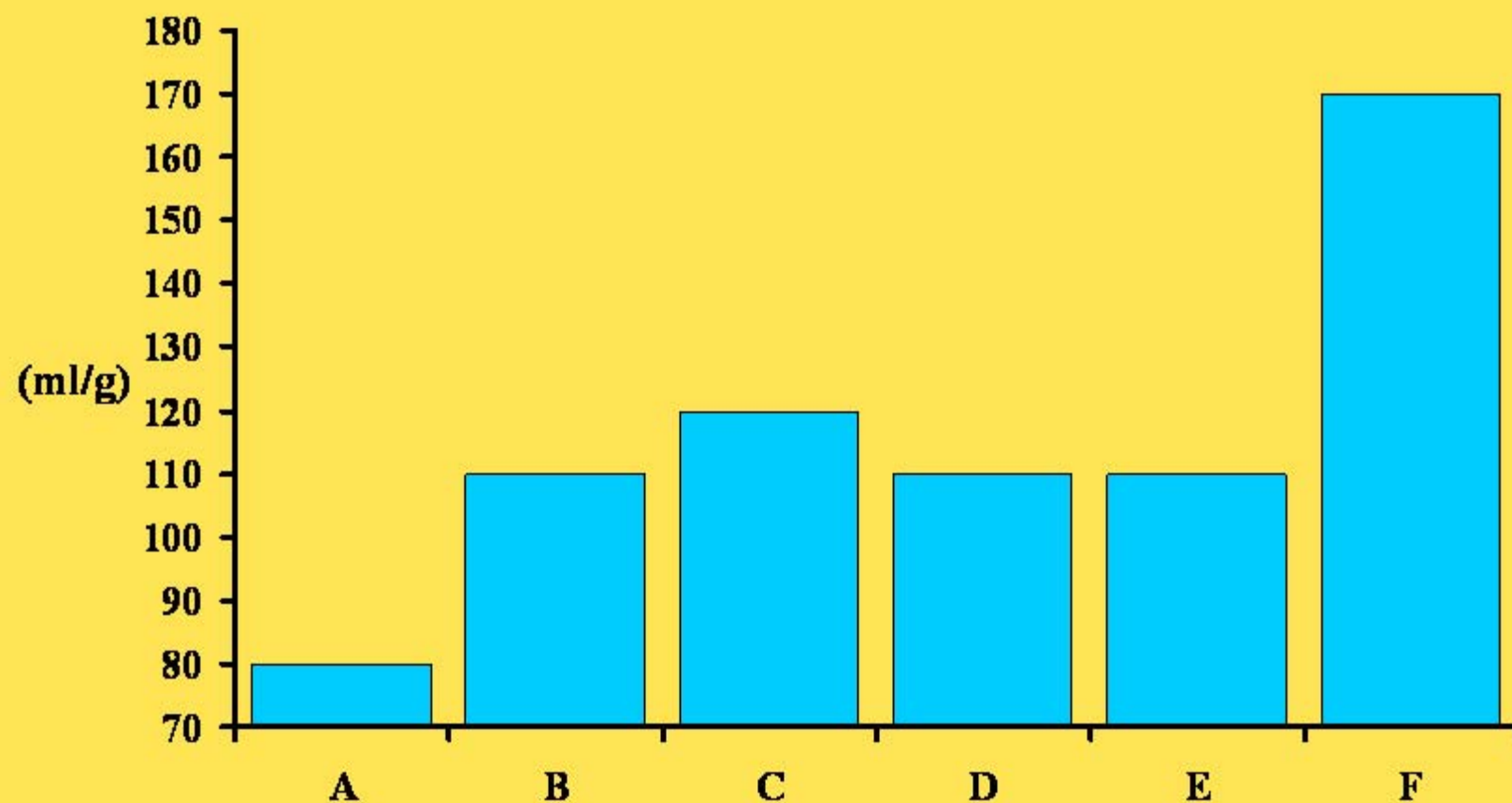


# Protein in RTD-Acidic Beverages

- **Top thinning or wheying-off**
- **Sedimentation and Shake back time**
  - Unbound sediments
  - Bound sediments
- **Mouthfeel**



# Emulsion Capacity



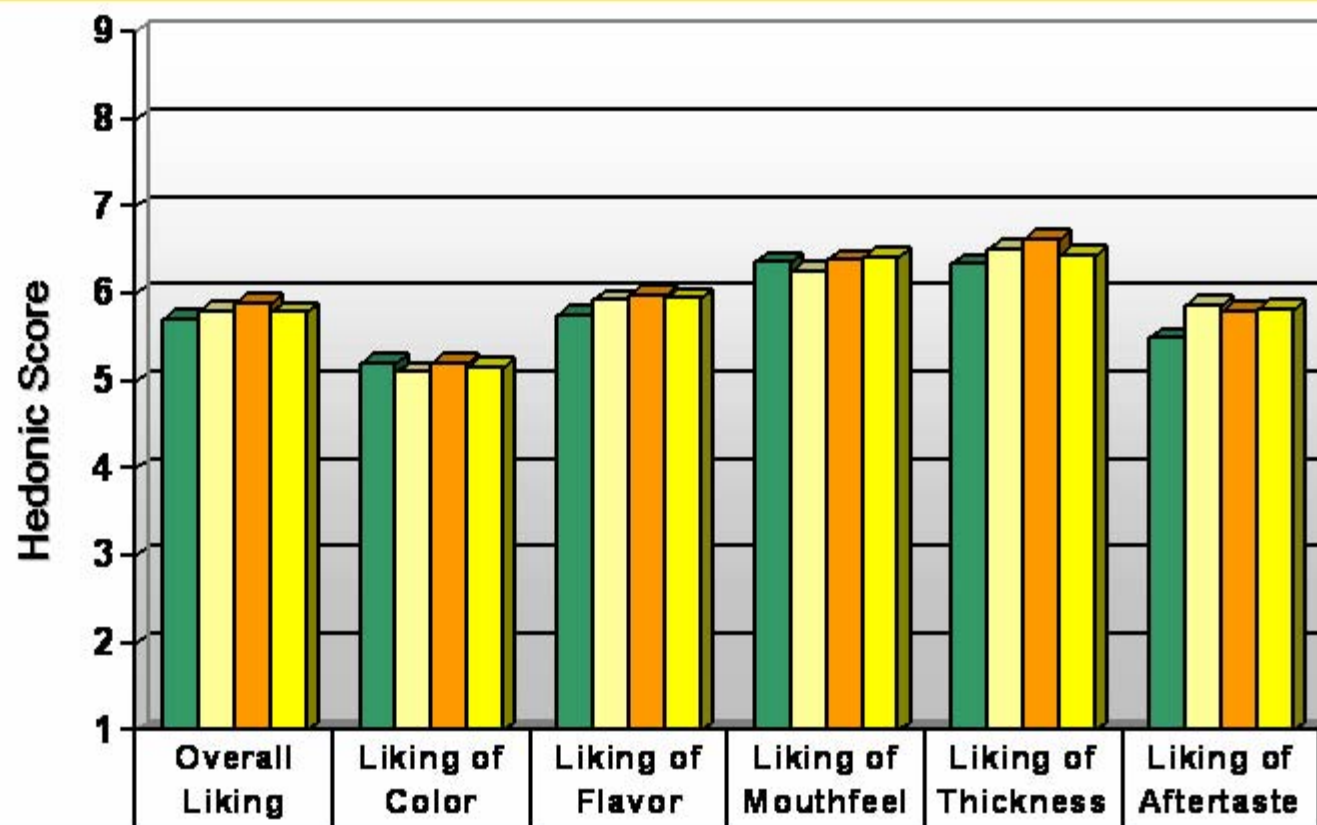
# Sensory:

- Soy is “healthy” and is a quality source of protein. ✓
- Soy proteins are very versatile functional food ingredients. ✓
- **Sensory: Protein ingredients should contribute positively to the final product overall flavor profile.**
  - *Will soy-containing products taste good?*

# Sensory Profile:

- **Aroma:**
  - Beany
- **Mouthfeel:**
  - Astringent
- **Taste**
  - Grain
  - Bitterness

# Synergy: Sensory Sweet Spot





## Synergy: Sensory Sweet Spot

- **Blends of 1% milk and Soymilk were equally preferred for Overall Liking compared to 1% milk.**

Products	Overall Liking	Flavor	Appearance	Mouthfeel
75% Dairy 25% Soy	6.87	6.88	6.79	6.69
50% Dairy 50% Soy	6.52	6.63	6.30	6.33
Fluid milk (1% fat)	6.46	6.38	6.99	6.43

- *7 g Ready-to-Drink beverage, 9 pt. Hedonic Scale; n=200.*

## Synergy: Sensory Sweet Spot

- **The soy/whey powder blend was equally preferred for Overall Liking & Flavor compared to an all whey blend.**

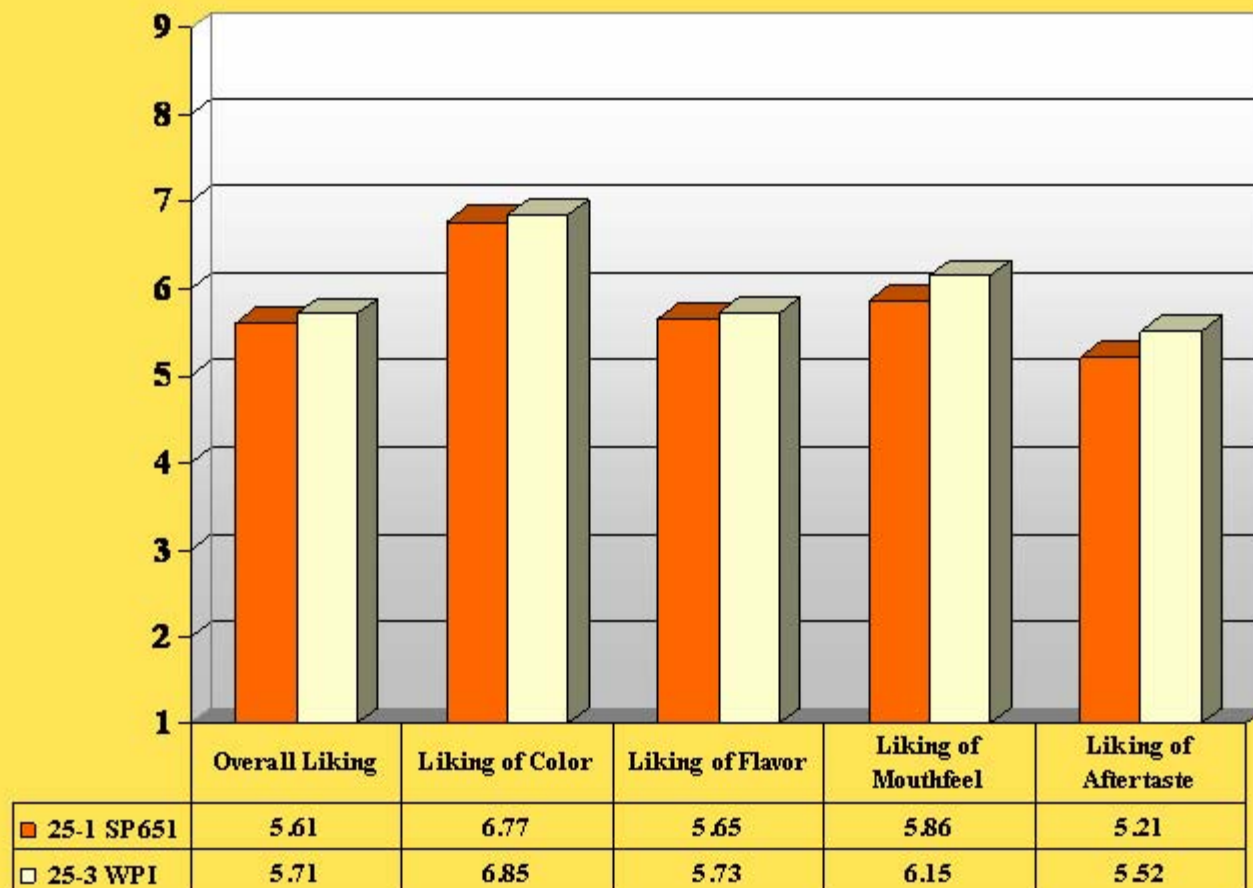
Products	Overall Liking	Flavor	Appearance	Mouthfeel
Soy/Whey blend	<b>4.72</b>	<b>5.18</b>	<b>5.37</b>	<b>4.57</b>
All Whey	<b>4.30</b>	<b>4.57</b>	<b>4.97</b>	<b>4.87</b>
All Soy	<b>4.38</b>	<b>4.52</b>	<b>6.08</b>	<b>4.70</b>

- *25 g Powdered beverage mixes 9 pt. Hedonic Scale, n=60.*

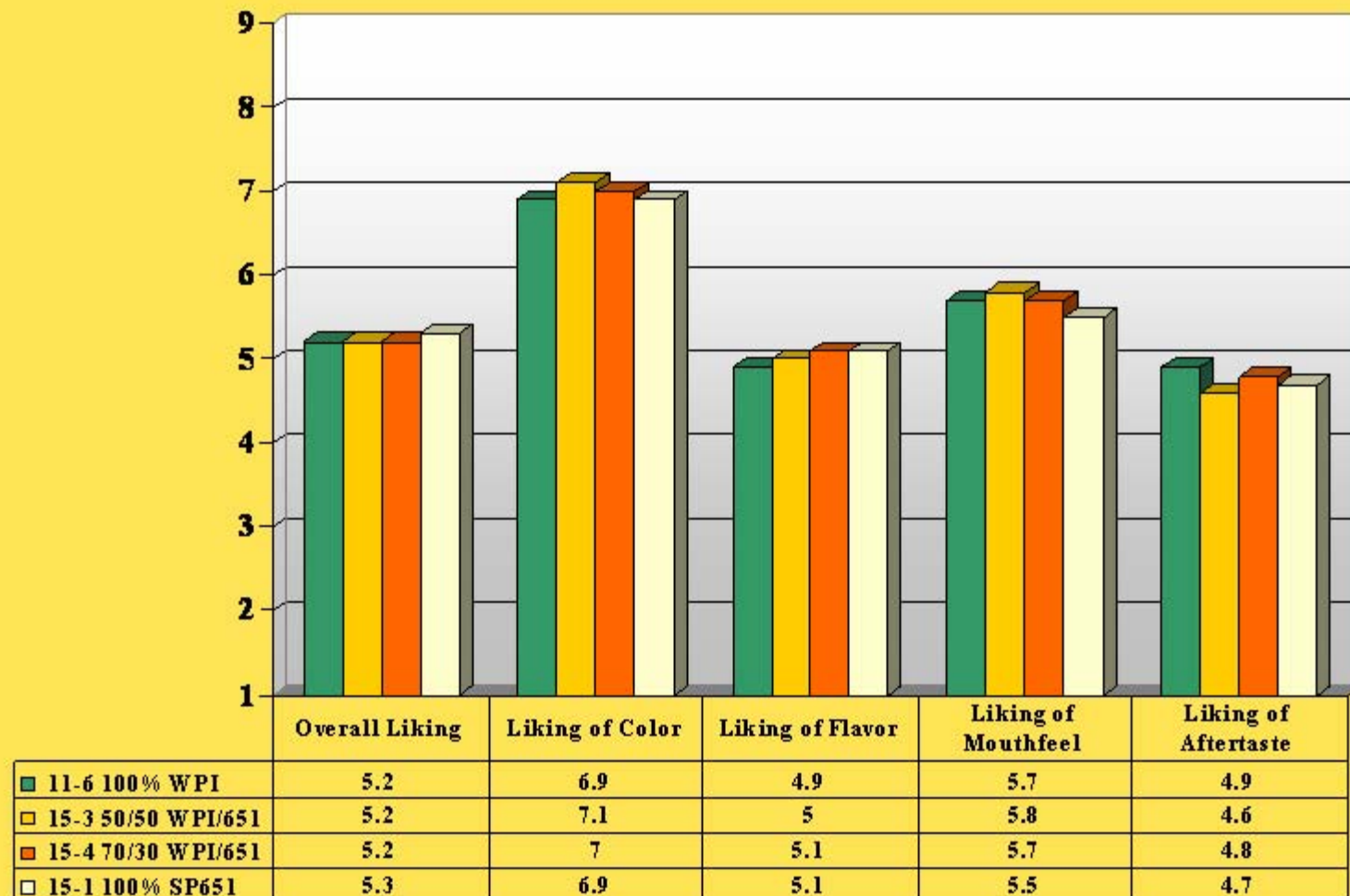
# Head-to-Head Comparisons of Value-Added Proteins

- **As a follow up to comparisons against fluid milk, head-to-head comparisons were made against individual value-added milk protein components.**
- **Model: Ready to Drink White Beverage model**
  - **Supro® Plus 651 (ISP with stabilized Calcium)**
  - **Whey Protein Isolate**
  - **Calcium Caseinate**

**In a White Beverage Model, Supro®651 is equally preferred for Overall Liking & Flavor compared to WPI.**

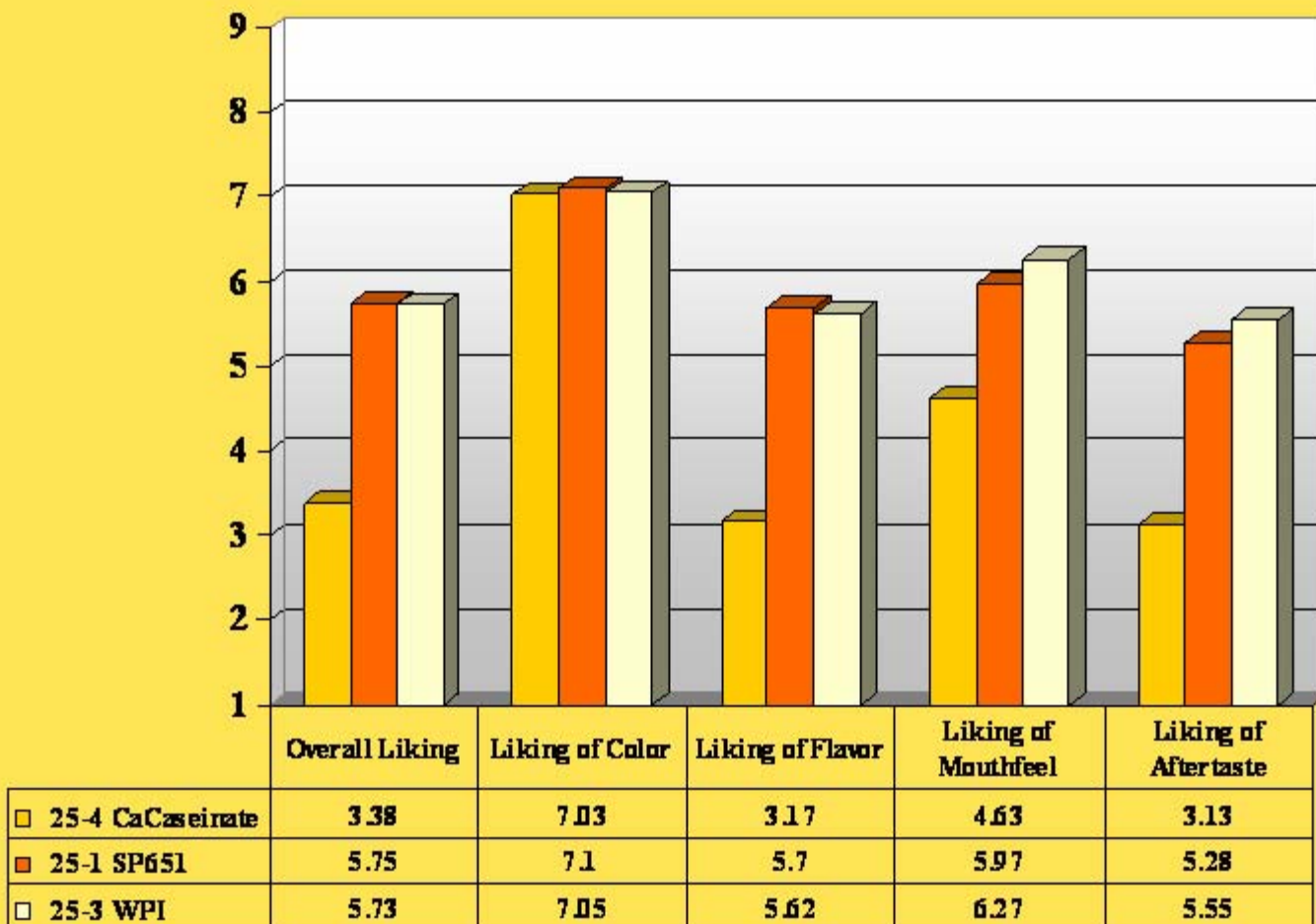


**In a White Beverage Model, Supro®651 & Supro®651/WPI blends are equally preferred for Overall Liking & Flavor compared to WPI.**



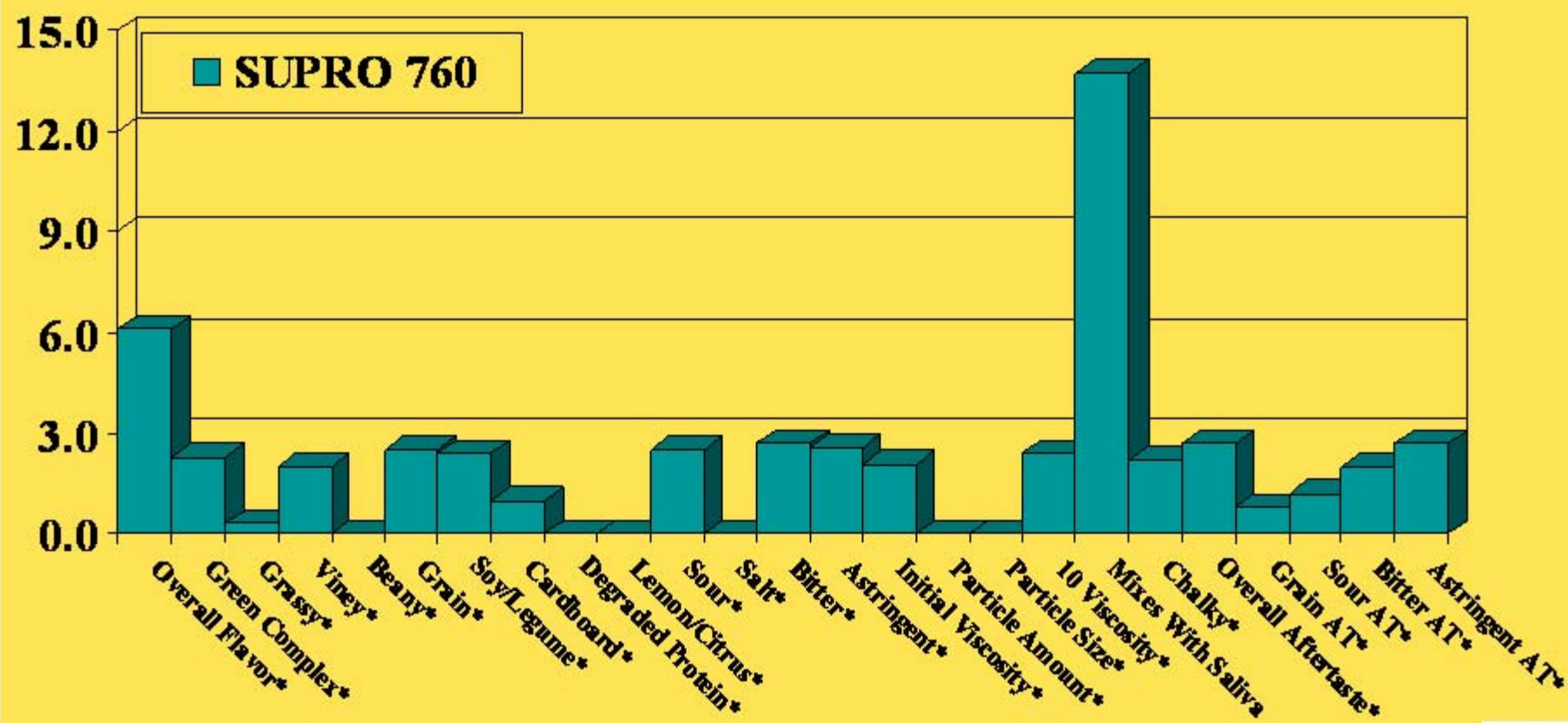


**In a White Beverage Model, Supro®651 was equally preferred for Overall Liking & Flavor compared to WPI and preferred over CaCaseinate.**





# Supro®760 Protein Profile



# Marketability:

- Soy is “healthy” and is a quality source of protein. ✓
- Soy proteins are very versatile functional food ingredients. ✓
- Soy proteins can accentuate the overall liking profile. ✓
- **Regulatory & Market Positioning: Proteins should contribute favorably to the marketability of the final product on the shelves.**
  - *Are soy protein ingredients consumer-friendly in terms of allergy, GM, and reasons-to-believe?*

# Allergy

- **Incidence of soy allergy is estimated at 0.5% of the population compared to 2-8% for milk allergy.**
- **Most customers that we worked with have found the value of using soy far outweighs the costs and efforts involved in effectively managing it as an allergen in production facilities.**

# Genetic Modification

- **Most suppliers, including Solae, offer choice, offering both standard commodity (GM) and identity-preserved, non genetically-modified (IP-non GM) options for most of their soy protein products.**
- **Free of BSE, Bovine Growth Hormones (rBGH) found in milk products**
- **Rigorous testing protocols and standards.**

# Phytoestrogen or Isoflavone

- **There is no credible science that has proven or indicated any ill-effects among either children or adults consuming soy protein that can be attributed to its phytoestrogen or isoflavone content.**



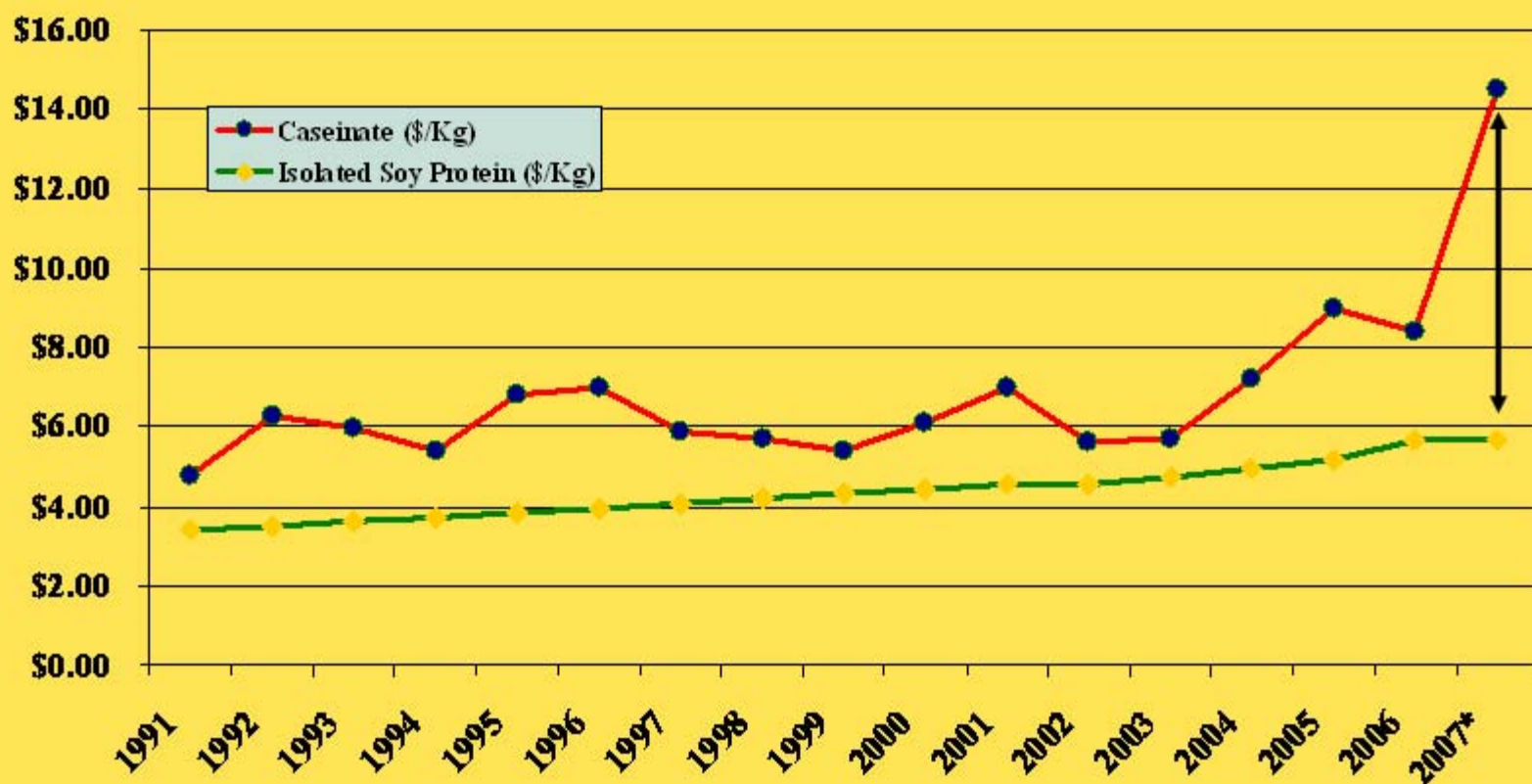
# How Do Soy Proteins Further Compete?

- **Sustainability vs. Cost (protein to protein)**
- **Stable Pricing and Stable Supply/Capacity**
- **Usage as the sole protein source in a growing number of applications.**
- **Even larger frequency of usage in combination with milk proteins.**

# Complementary Nutrition & Health Benefits When Blended with Dairy Proteins

	High Quality, Complete Protein	Adds Lean Body Mass	High in Branched-Chain Amino Acids	High in Glutamine & Arginine	Digestion Rate	Attacks Free Radicals
Soy Protein	✓	✓		✓	Intermediate	✓
Whey Protein	✓	✓	✓		Fast	
Casein	✓	✓	✓		Slow	
Combination	✓	✓	✓	✓	Prolonged	✓

# Average Caseinate Prices vs. ISP (\$/KG) 1991-Present (100% Protein Basis)



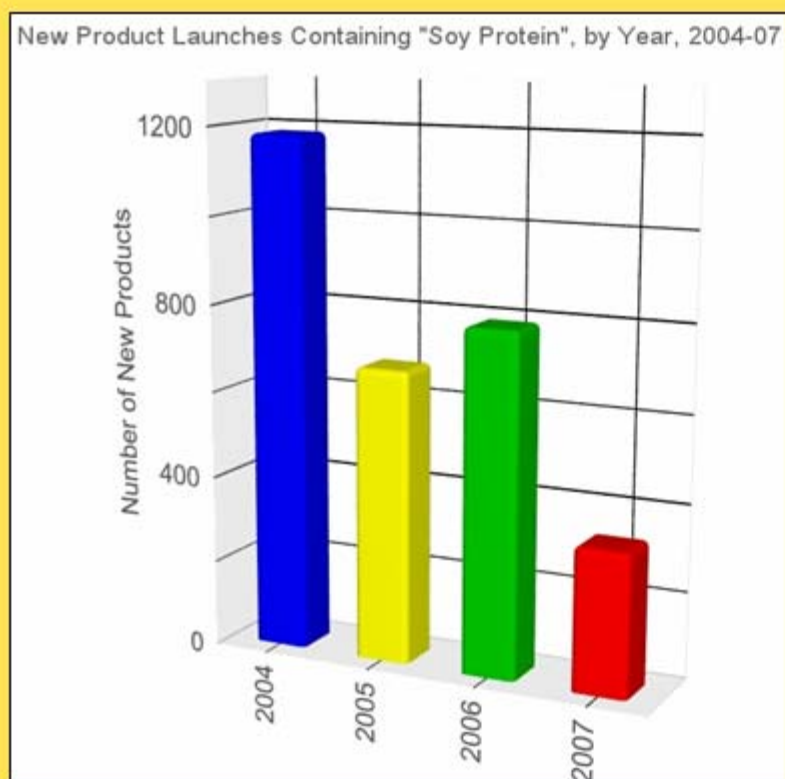
\* 2007 = October 2007, Dairy Market News

\* Source: Dairy Market News, Acid Casein + \$0.25/lb.; 88% protein

# Soy Product Launches (North America)

- **Product launches with “soy protein” so far in 2007 are tracking slightly behind 2006 numbers.**
  - 178 products were launched in Q2 with soy protein, and 330 total through June.
  - 2 of the top 10 companies launching soy protein containing foods so far this year were private label brands – Loblaws and Shoppers Drug Mart.
- **Protein-positioned products rebounded slightly in Q2 vs. Q1 (49 vs. 32 launches in Q1).**
- **129 products with “whey protein” were launched in Q2, and 134 products with “caseinate”.**

# Soy Product Launches



\* Thru June 2007

Date Published	Number of New Products
2004	1,183
2005	676
2006	788
2007	330*

(Search Criteria = "Soy Protein  
AND NOT Hydrolyzed Soy  
Protein" in Products' Ingredients)



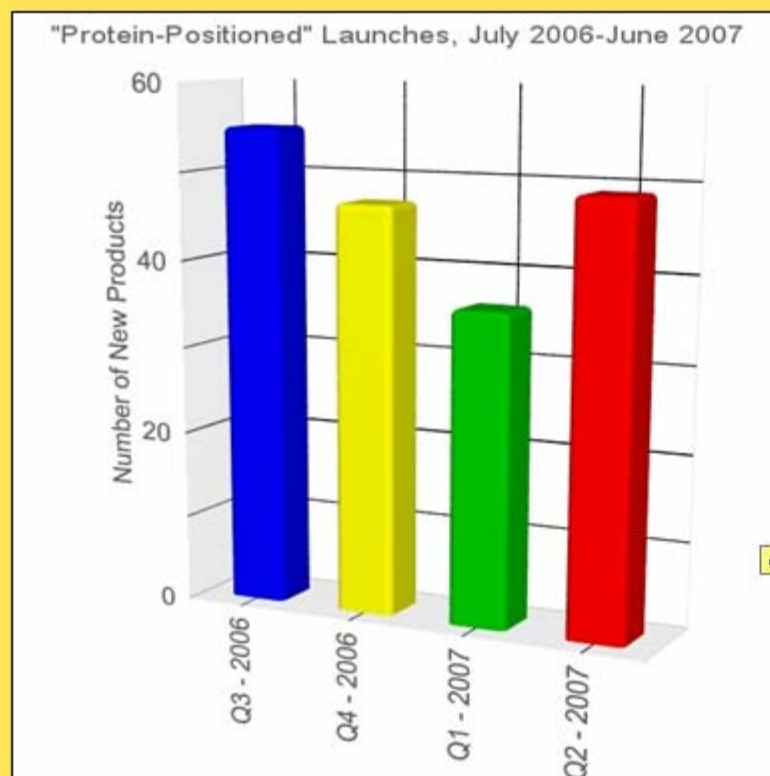
# Soy Product Launches



Date Published	Number of New Products
Q3 - 2006	216
Q4 - 2006	174
Q1 - 2007	152
Q2 - 2007	178

**Total Launches,  
Last 12 Months = 720**  
**(Search Criteria = "Soy Protein  
AND NOT Hydrolyzed Soy Protein"  
in Products' Ingredients)**

# “Protein-Positioned” Product Launches



Date Published	Number of New Products
Q3 - 2006	55
Q4 - 2006	47
Q1 - 2007	36
Q2 - 2007	49

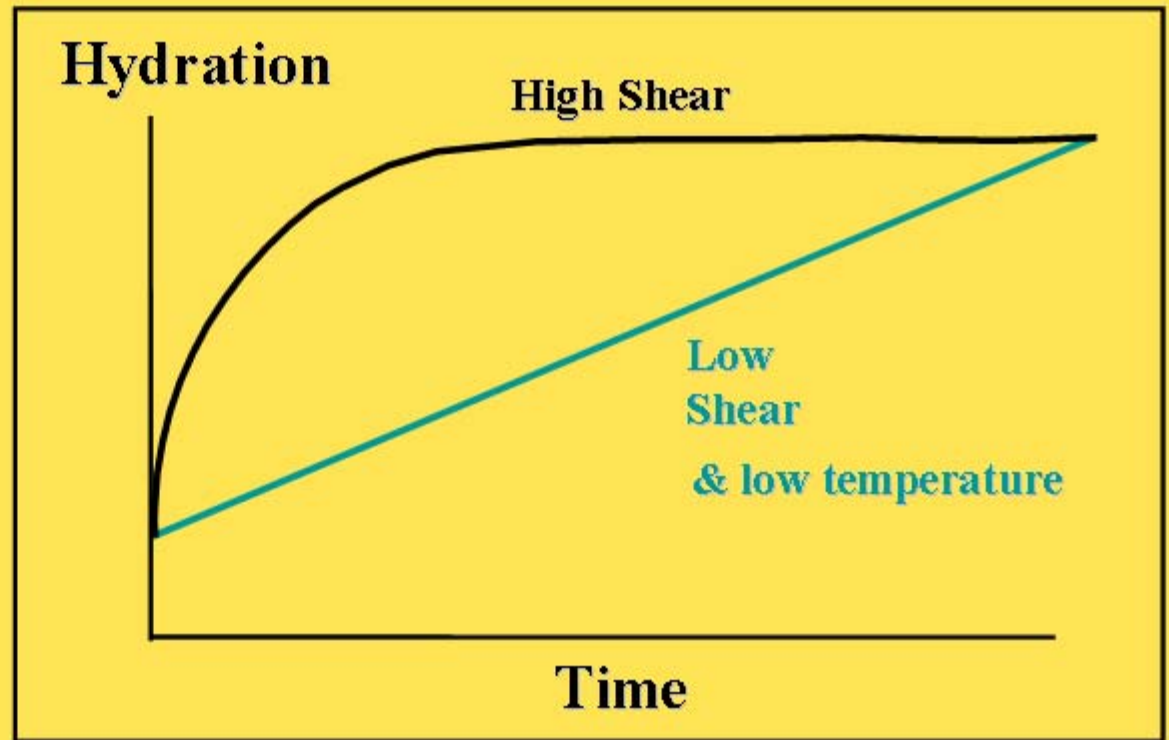
(Search Criteria = “Protein” in the product description.)

# Application Success Is Dependent Upon . . .

- **The right protein selection & the right . . .**
  - **Positioning**
  - **Total formulation**
  - **Processing**

# Processing Example: Protein Hydration

- Time
- Temperature
- Shear or Energy



# **Control of soy flavor in applications to meet consumer expectations.**

- **Advances in soy flavor/processing technology has created even higher performing soy proteins.**
- **For example, Solae offers a selection of highly-functional soy protein isolates for flavor, mouthfeel, color and texture applications.**



# Current Technologies for RTD-Acid beverages

- **Standard acid pectin process using Supro® XT-40**
- **Supro® XT-219D**
- **Highly-hydrolyzed proteins**
- **Hybrid proteins**
- **High-solubility proteins without pectin**
- **Patent-pending *in-situ* stabilization technology**

# Emerging Technologies



US 20070014909A1

(19) **United States**

(12) **Patent Application Publication**

**Mai et al.**

(10) **Pub. No.: US 2007/0014909 A1**

(43) **Pub. Date: Jan. 18, 2007**

(54) **ACIDIC, PROTEIN-CONTAINING DRINKS  
WITH IMPROVED SENSORY AND  
FUNCTIONAL CHARACTERISTICS**

(21) **Appl. No.: 11/183,344**

(22) **Filed: Jul. 18, 2005**

(76) **Inventors:** Jimbin Mai, St. Louis, MO (US);  
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## **Publication Classification**

(51) **Int. Cl.**  
**A23L 2/00** (2006.01)

(52) **U.S. Cl.** ..... **426/590**

(57) **ABSTRACT**

Processes for producing acidic, protein-containing drinks are disclosed. Specifically, the processes comprise producing acidic, protein-containing drinks comprising plant protein material. The acidic, protein-containing drinks have improved sensory and functional characteristics such as reduced viscosity, improved sedimentation rate, and improved mouthfeel.

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# Formulation Success - Getting The Flavor Right

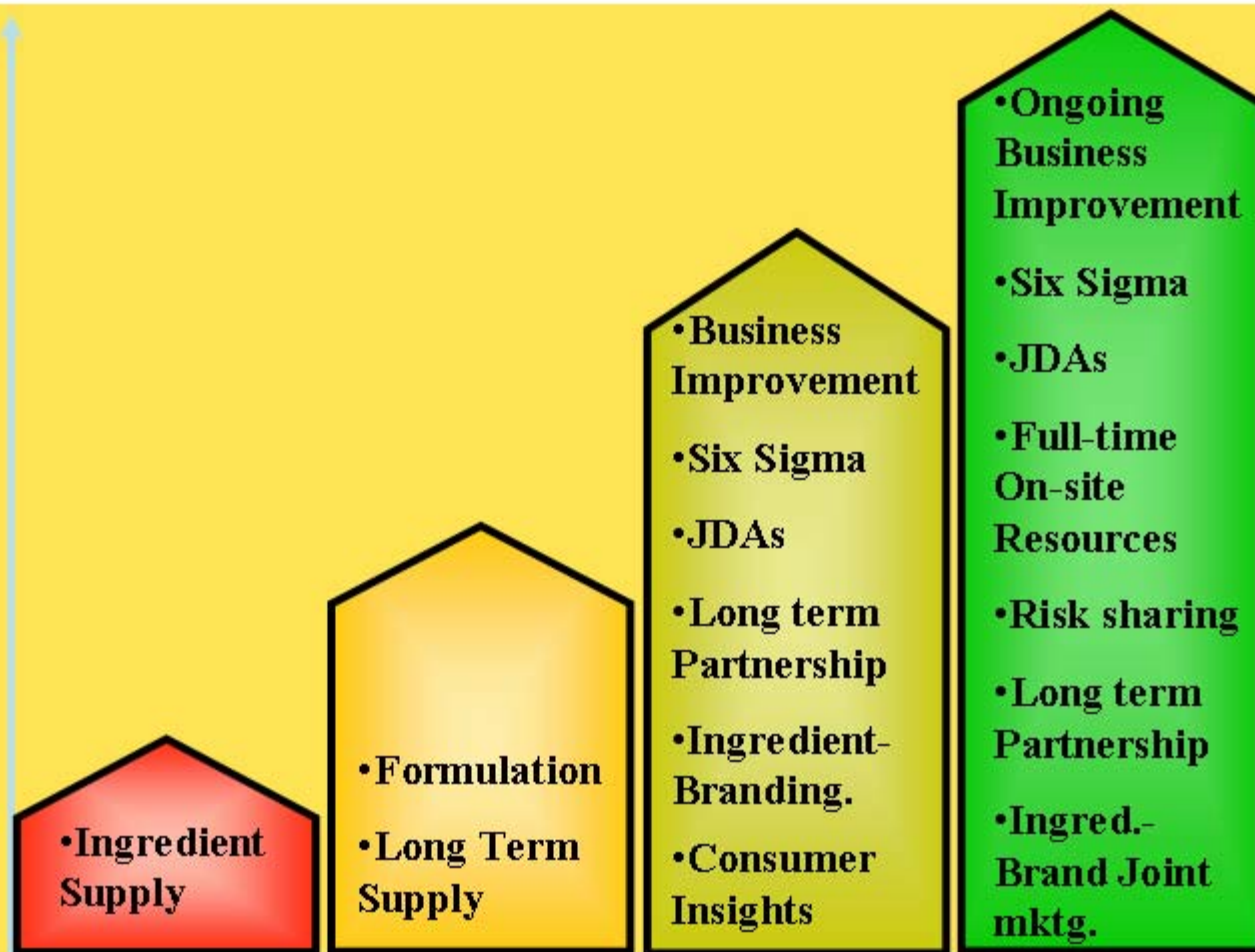
- **Interactions between ingredients, packaging and processing can be key to flavor and other sensory effects in the end product.**
- **Partnerships with other ingredient companies has resulted in better flavor & formulation technology:**
  - **Soy-specific flavor systems/masking agents.**
  - **Specialized stabilizer system.**

# The Solae Company Provides Optimum Solutions

- **Global reach, local action**
- **More than ingredients, innovative solutions**
- **Application expertise & nutritional science leadership**
- **Sophisticated Sensory Program**
- **Investment in flavor & functionality breakthroughs**
- **Gold standard IP program and quality guarantee**
- **Joint Marketing & Media & Public affairs:**
  - **Sharing consumer insights & market data**
  - **Enabling maximum flexibility to design the best tasting, most profitable solutions.**

# Creating Value

\$ MM  
Customer  
Business  
Impact



Degree of Engagement



# Summary

- **Protein quality is not compromised by replacing dairy with soy protein. Both soy and dairy are sources of high-quality proteins.**
- **Soy protein product offerings are diverse and versatile. They can be matched to the needs of highly specialized application or specific formulation.**

# Summary

- **Sensory evaluation in both beverages and bars have confirmed that blends of dairy and soy often perform better on several sensory dimensions than either all-soy or all-dairy.**

# Summary

- **In other systems, we have often been able to enable product improvements or maintain similar scores in consumer preference.**
- **Reformulation for cost-savings can easily be paired with an initiative to re-position existing product with a new consumer benefit on either a taste or nutrition dimension.**

# Summary

- **In addition to product positioning, processing and total formulation are also opportunities for process improvement.**
- **Leverage expertise among your supplier base.**
  - **Take advantage of their experience and knowledge in product, processing & formulation technology as well as consumer insights on soy proteins.**

# Thank You!

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