

Proteins in Beverage: Approaches, Challenges and Opportunities

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Introduction

As demand and acceptance of protein-containing products increases, so too have the various options and sources of protein that are available. Each source, and each form of protein within a particular source, has its own taste attributes, properties, benefits and challenges. This white paper will provide an overview of the physical and organoleptic properties of some of today's most popular protein sources, and will also cover approaches and considerations that a product developer should keep in mind when working with various proteins. While the technical descriptions and techniques discussed in this paper are in terms of beverage use, the principles will in many cases be transferrable to other food applications.

Protein's Widening Appeal

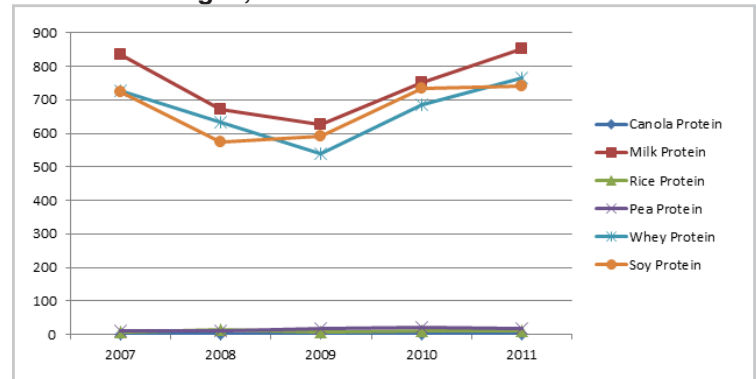
Health-conscious consumers are becoming more aware of the benefits of protein in the diet. Following the typical ingredient growth curve, the use of protein began with niche users, such as sports nutrition enthusiasts who are motivated by the benefits for specific needs, and is now moving into products targeted for a wider consumer audience. This growth curve has created development opportunities to feature protein as a healthy ingredient across many product applications.

Of the possible health benefit platforms for protein, weight management is currently the strongest, driven by high-quality nutrition research. As part of weight management, consumers are becoming more interested in satiety products, which are intended to give the consumer a feeling of fullness for an extended period of time. Products in the satiety category typically rely on protein and/or fiber, for which the satiation properties are supported by numerous scientific studies. As protein and its health and wellness benefits become more familiar to consumers, other development areas will gain traction. For example, sarcopenia, the loss of skeletal muscle often associated with aging, has significant growth potential as the Boomer population ages.

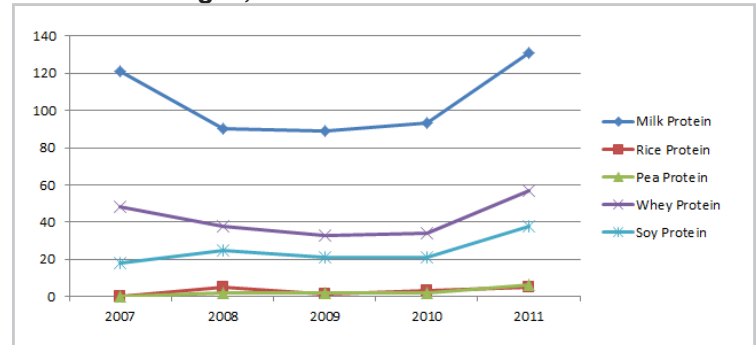
Moving from sports niche to wellness for the masses will take time, but it is happening at a fairly strong pace. Two key constraints for the mainstreaming of protein are taste and consumers' lack of familiarity with protein. As new

health benefits of protein are validated, consumers will demand a large variety of product choices. This means product formulators will be seeking the best functional protein to deliver on each key consumer health need. The following charts illustrate the growing variety and use of a number of proteins in foods and beverages in North America.

Proteins over time, North America Food & Beverages, 2007–2011 Launches¹



Proteins in Beverage, North America Food & Beverages, 2007–2011 Launches¹



Taste Challenges of Protein

While consumers today expect their food and beverage products to have multi-functional benefits, they still have high expectations that those products deliver great taste along with efficacy in terms of the specific health benefits. Because each type of protein has its own inherent taste, formulating high doses of protein into beverages can produce distinctive tastes and textures perceived as unappealing. It is important to be aware of the taste and texture properties of the proteins being used, and of the approaches one can take to overcome these challenges. The following table demonstrates the unique contributions to flavor that each protein imparts.

Protein Type	Common Taste Descriptors
Whey	Grassy, Hay, Cheesy, Astringent
Soy	Beany, Green, Bitter
Pea	Earthy, Nutty, Savory

Selected Beverage Protein Sources — An Overview of Physical and Organoleptic Properties

Whey Protein

Milk Protein is made up of two main types of protein, whey and casein, with whey comprising 20% of the milk protein fraction. Whey protein is rapidly digesting, with a high biological value. These two attributes together make whey an excellent choice when formulating a product which calls for immediate protein availability.

Unlike many proteins sources, whey will remain in solution over a wide range of pH values, which allows its use in acidic beverages. It can often stay in solution without the aid of a stabilizer. Whey can also be specially manufactured to dissolve clearly in solutions when used under acidic conditions.

While whey protein resists fallout under a range of pH values, it is relatively susceptible to heat. Extensive or prolonged exposure to high temperatures can cause whey protein to denature and partially flocculate or fall out of solution. Whey protein has an astringent mouth drying effect at low pH values due to the positively charged whey proteins interacting with the negatively charged proteins found in the saliva – this interaction causes proteins to flocculate on the tongue creating an astringent effect.

Soy Protein

Soy protein powders result from defatted soy beans, with the soy protein mostly isolated from the carbohydrates. Soy does not contain lactose, the principle sugar found in milk, so it is a popular alternative to dairy. Soy proteins also contain a complete amino acid profile, a characteristic not shared by all vegetarian-suitable protein sources.

Products containing soy may also be able to make a heart health claim: “25 grams of soy protein a day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.” Though currently the most popular alternative to dairy proteins, there is a stigma with a portion of male consumers concerning the use of soy protein in muscle-building type applications, due to certain isoflavones found in soy which have been shown to exhibit weak estrogenic activity (there is research that is both supportive and unsupportive of the premise that soy isoflavones do have a measurable effect in males).

Many soy proteins have a beany taste that can mask or overpower certain light flavors. Soy proteins will typically require a stabilization system to prevent sedimentation in RTD beverages.

Pea Protein

Pea protein is another non-dairy protein source with a complete amino acid profile. It also provides an alternative if soy and dairy allergens must be avoided.

Pea proteins usually require additional stabilization to avoid sedimentation. The mouthfeel and viscosity that pea protein adds to a solution is relatively high compared to many other protein sources, and the strong inherent earthy notes can occasionally be difficult to work with. It is likely that a product developer will find that flavors which have performed well in products utilizing other sources of proteins do not necessarily translate well when working with a beverage containing pea protein.

Flavoring a Protein Beverage — Approaches and Considerations

It is important to consider each ingredient of a food product as a contributing factor in the finished product's flavor. The degree to which a particular ingredient affects flavor depends on a number of factors, but most importantly, the characteristics of its inherent taste profile and the amount of the ingredient that is found in the product. Proteins inherently have a taste profile that is readily detected by the human senses². Additionally, as protein is one of the three fundamental macro-nutrients, along with carbohydrates and fats, it is often found in relatively high quantities compared to other functional ingredients.

These two factors typically result in added proteins disproportionately affecting the flavor of a beverage or food product compared to many other common ingredients. Combined with the fact that proteins are increasingly being used in a wider variety of product categories, it is easy to see why product developers must be armed with both knowledge and tools to overcome these taste challenges.

Improving Taste Through use of Compatible Flavors

Earlier in this report, taste descriptors were highlighted, illustrating differences in the flavor associated with each particular protein. These inherent flavor differences can have a critical effect on the overall taste of a beverage. It is advantageous to assess these factors early in the development process, so that flavor concepts that will be compatible with the particular protein source are used. While there is no concrete rule to which flavors will work

well with a given protein, there are a few approaches that can make the flavor aspects of the development process easier.

- One approach would be to select a flavor system which contains aspects of the inherent flavors of a particular protein. For example, if you are using a protein that delivers strong earthy notes, such as pea protein, then using a flavor that also has earthy aspects to it, a nut flavor perhaps, can sometimes work to overcome the undesirable attributes of the protein.
- Another method which shares a few principles of the first approach, also involves utilizing knowledge of a particular protein's flavor attributes; however, instead of masking these notes through the use of congruent flavors, the inherent notes of the protein are utilized as part of the flavor system. This strategy is best explained through an example:
 - Consider soy protein, which often brings with it inherent green notes, and a strawberry flavor, which can have a number of characteristics based on its composition. A strawberry flavor that is strong in green notes may taste unbalanced in the presence of soy, since the green notes inherent in soy protein will have an additive effect with the green notes of the strawberry flavor. However, if one selects a flavor that is higher in other flavor characteristics, say jammy or red notes, and has a lower amount green notes, the inherent green notes of the soy protein can be used to create a balanced overall strawberry flavor.

Summary

There is much opportunity in the beverage marketplace regarding the inclusion of protein as an ingredient. Unique flavor and formulation issues can act as potential hurdles that may arise during the formulation of protein beverages. Understanding the properties and inherent flavors of a particular protein source and selecting complementary flavors are critical steps to achieve the success of a protein beverage from a taste standpoint.

Look for the next white paper installment on proteins, in which we will discuss why certain proteins and their various forms are chosen over one another, examine the properties of casein, rice, and canola protein, and also investigate the importance of sweeteners and acid systems in protein beverages and how these two factors can be optimized in a protein-containing system to improve taste. Please contact FONA International for further information on formulating with proteins.

References

¹ Mintel GNPD

² Zuker, Charles et al. An Amino Acid Taste Receptor. Nature 416, 199-202 (2002).

³ Mintel Oxygen