How to Bake High Protein Products

High protein baked goods, a popular choice with consumers, are characterized by fortified formulations with a wide variety of protein-rich ingredients. The options are many, including milk and whey protein concentrates or isolates, soy protein concentrates or isolates, pea protein, chickpea flour, dried egg solids, almond or nut butter, and nutritional yeast. [1]

Health concerns associated with weight gain and over consumption of sugar have been the main detractors of the baked goods markets. However, novel nutrient-dense products, like ones high in protein, have an opportunity to counteract the decreasing consumption of bakery products due to these health concerns.[3]

Among the most relevant markets of high protein baking by type of bakery products, the protein cookie market leads the way with an expected CAGR of 5.15% from 2019 to 2027. Cake protein bites are also considered to have a healthy expected CAGR over the same period of time. [4,5]

Ingredient Solutions

High protein baking involves the addition of protein rich ingredients to increase the percentage of protein per serving size. However, it's also key to improve the quality of the protein consumed, which is associated by the bioavailability of the protein, and the quantity of essential amino acids present in the food product.

Complete proteins, such as whey proteins, are considered of higher nutritional quality as they contain all essential amino acids in the proportions needed. Incomplete proteins don't provide all essential amino acids and are considered of lower quality. However, when correctly combined, incomplete proteins can provide all required essential amino acids.

Usually the accepted method for determination of protein quality is either the Digestible Indispensable Amino Acid Score (DIAAS) or the the Protein Digestibility Corrected Amino Acid Score (PDCAAS).[1]

Some label claims for products with increased protein are "high in protein", "rich in protein," or "excellent source of protein." This claim requires that the finished product contains at least 20% protein per reference amount customarily consumed per eating occasion (RACC), or simply 10 g protein per serving size of 50 g of product. In the U.S., the Daily Reference Value (DRV) for protein is 50 g per day. This is based on a reference caloric intake of 2,000 calories.

High Protein Ingredients

Due to the need to both increase and improve the quality of the protein content, a wide variety of ingredients are used in novel formulations. A few examples are:

Type of Ingredient	Ingredients	Protein Content (%TW)	PDCAAS
Dairy	Whey Protein Isolate	90%	1.00
	Caseinates	92%	1.00
Beans and Pulses	Chickpea powder	25 - 28%	0.71
	Faba bean powder	20%	0.47
	Pea protein powder	75%	0.92
	Soy protein isolate	88%	0.99
Eggs	Egg whites	10%	1.00
	Egg yolks	15%	1.00
Grains / Pseudo Grains	Barley	12%	0.61
	Whole wheat	9 - 15%	0.00
	Buckwheat	12%	0.80
	Triticale flour	10 - 15%	0.52
Nuts	Almond butter	24%	0.88
	Almond protein powder	17%	0.88
	Macadamia	7%	0.04
	Pecans	9%	0.71
	Walnuts	15%	0.86
Yeast	Nutritional yeasts	50%	0.82-0.90
Seeds	Amaranth flour	16%	0.72
	Quinoa flour	14%	0.92

Baking Tips
High Protein

Protein addition to traditional baked goods presents several challenges, given that protein, especially gluten, contributes to several functional properties of bakery systems.

FUNCTIONS OF PROTEIN IN BAKED GOODS[1]

- **Structure:** proteins are typically the base structure of baked goods, forming unique networks that provide stability to the product.
- **Binding:** associated with the addition of egg proteins that provide a unique molecular structure and flexibility.
- **Aeration:** proteins from eggs produce foams when whipped, essential for volume build up, lightness and smooth mouthfeel.
- **Color and flavor:** participate in Maillard reactions responsible for desirable flavor and crust browning.

CHALLENGES OF INCREASED PROTEIN IN BAKED GOODS

- **Increased** hardness and thickness of cookies
- **Decreased** spread factor and spread ratio of cookies
- **Disrupted** protein network building from other non-gluten proteins
- **Weakened** gluten network in breads because less flour is used
- **Affected** dough handling
- **Affected** mixing time, water holding capacity and elasticity due to the presence of non-functional proteins
- **Affected** product taste, depending on the protein addition level

The addition of protein does not always mean the improvement of the protein quality. Several protein sources may have substances or factors that actually hinder protein and amino acid digestibility. Some of the most commonly found anti-nutritional factors in protein-based products are glucosinolates, trypsin inhibitors, haemagglutinin trypsin inhibitors, hemagglutinins, tannins (commonly found in legumes and cereal products) and uricogenic nucleobases in yeast protein products.[6]

Baking Tips
High Protein (cont.)

When working with non-functional proteins, some considerations must be taken into account to create baked goods with acceptable organoleptic properties: [7,8]

- **Add wheat gluten isolate or vital wheat gluten** when using non-functional proteins such as rice, pea, and soy to compensate for the disruption of the gluten network from the non-functional ingredients.
- **Choosing the right type of milk or whey protein** can to some extent compensate for less gluten network caused by decrease of flour.
- **Add whey protein isolates** at levels of 2-5% to increase the protein content and improve texture, air incorporation and product moistness.
- **When adding protein powders or isolates**, a partial substitution of flour is recommended so that the overall solid content of the product doesn't significantly increase with an increasing protein content.
- **Using dairy- or plant-based protein isolates** may decrease the amount needed to reach the desired high protein claim.
- **Proteases may aid in the production of baked goods** that require low levels of gluten development by reducing the elasticity of the dough, and thus, reducing cookie shrinkage and improving cookie spread ratio.
- **When working with variable sources of protein**, hydration rates may differ from the original recipe due to the different water absorption capacities of each protein. Some types of protein may retain water up until baking and cause significant water loss that may affect the final product.
- **Canola protein, flaxseed protein, safflower protein and whey fat concentrate** may improve emulsification properties.
- **Protein enhances the Maillard reaction**, so adjust baking time and temperature as the baked product will brown faster.

How will added protein affect the shelf life of the final product?

Shelf life is mainly determined by two factors. First, is the microbial spoilage caused by airborne mold spores that may come in contact with the product as it leaves the oven. The second factor is staling, which is mainly caused by the retrogradation of starch and moisture loss. Protein addition may aid in baked good's shelf life. Their water holding capacity that may decrease the availability of water for microbial growth, and may also decrease the moisture loss rate of some products.[10]

How easy is it to make a high protein cake?

It is not advisable to use vital wheat protein to increase the protein content in cakes as this would make a firmer and chewier cake. A better option is wheat protein isolate or whey protein isolate. These ingredients have been extensively studied in cake production, and have shown promising results with levels of up to 20% with an increase of the protein content of around 50-100% with high acceptance rates.[11]

Similar studies have been carried out for fermented lupin powder (FLP) and fermented soy powder (FSP) with less promising results. The addition of these types of protein powders decrease loaf volume and product acceptability, with FLP showing a lower negative effect than FSP.[12]

Is whey protein a good ingredient for improving protein?

Yes, whey protein powder or isolates have a PDCAAS of 1.0 making it a great source of quality protein. It also can increase overall quality by improving volume and bread crumb texture, enhancing cake batter gelation, increasing cake volume, and improving cookie tenderness and color.[13]

Can you make high protein, gluten-free products?

Yes, in fact several gluten-free products have a higher protein content due to the blending of flours commonly used to replace wheat flour. Given that gluten is the main protein responsible for the rheological properties of baked goods such as breads, its substitution is partially accomplished with the use of other protein sources that may partially contribute to the functional properties required for gluten substitution.

The use of legume-based or alternative pseudo-cereals, and the blending of several types of non-wheat flours, a protein source and a hydrocolloid is typical for the production of gluten-free products.[14] The right combination of milk and whey proteins can create dough properties that reduces or removes the need for hydrocolloids.

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