Soy technical forum report

Enhancing soy potential in plant-based meat: strategic guidelines and research opportunities

gfi Brasil

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The Good Food Institute is a non-profit organization working globally to accelerate innovation in the alternative protein market. We believe that the transition to a more sustainable food system is fundamental to addressing the climate crisis, decreasing the risk of zoonotic diseases, and feeding more people with fewer resources. That is why we collaborate with scientists, investors, entrepreneurs and government agents to develop plant-based, cultured, or fermentation-enabled food products.

Our work is focused on three main areas:

In **Corporate Engagement**, we support companies of all sizes to develop, launch, and market alternative protein products, offering tools that assist startups and entrepreneurs in their business strategies. We also provide market intelligence to help companies make decisions, conducting research to identify and overcome challenges.

In **Science and Technology**, we fund cutting-edge research on alternative proteins, foster collaboration between scientists, companies, and governments, publish data and findings to drive scientific progress, and design educational programs to build the capacity of the next generation of leaders in alternative proteins.

In **Public Policies**, we advocate for public policies that support the development and marketing of alternative proteins, work with governments to create a favorable regulatory environment, educate the public about the benefits of alternative proteins, monitor the political landscape, and defend the interests of the sector.

With this work, we seek solutions to:

- **Safely, equitably and sustainably feed nearly ten billion people by 2050;**
- **Contain climate change caused by the current food production system;**
- **Create a food production chain that does not depend on animals;**
- **Reduce the contribution of the food sector to the development of new infectious diseases, some of which with pandemic potential.**

In just over six years of operation in Brazil, GFI has already helped the country to become one of the main players in the global plant-based protein market. The goal is to continue conducting this work to transform the future of food, promoting new protein sources and offering alternative proteins analogous to animal-based proteins.

Disclaimer

The strategic guidelines and research opportunities presented in this report were developed by *The Good Food Institute* Brasil by systematizing technical contributions collected in all stages of the Soy Technical Forum held between February and March 2025. This process included a structured technical form and a live meeting with experts from academia and industry. Although this report systematizes challenges and opportunities based on technical insights from experts, there was no systematic consideration of the feasibility of implementing the solutions discussed.

The quantitative data presented in the Appendix reflect the opinions of the participating experts, which were based on the questions proposed in the technical form and their individual experiences. These data are based on exploration and opinion; they are not statistically representative nor constitute an absolute scientific truth. In addition, they were not presented in a prioritization order.

In this report, the GFI had the role of surveying, consolidating, and systematically distributing insights from reliable sources, and the topics listed here are not investment recommendations, but rather a means of sharing technical information. Possible projects that derive from this knowledge shared by GFI must undergo further technical assessment, with rigorous analysis of commercial, regulatory and logistical feasibility of each alternative before investment decision-making.

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Introduction

Currently, soy plays a central role in the development of plant-based meat globally. In Brazil, more than half of the plant-based products available on the market use soy as the main source of protein, according to a Labeling Study carried out in 2023 with 349 products. Its consolidated use in textured, concentrated and isolated forms makes it one of the most strategic ingredients for the advancement of the sector.

Despite the wide use of soy in the formulation of plant-based meat and its strategic relevance in the alternative protein sector, the soy production chain still faces important challenges in the context of human nutrition. Although there are already protein ingredients with superior technofunctional and sensory performance, capable of meeting the expected texture, juiciness and flavor of products with higher sensory complexity, these ingredients still show significant cost barriers that limit their wide adoption. These limitations are directly reflected in the experience and perception of end consumers. The GFI Brasil Consumer Survey showed that 41% of Brazilians who do not consume plant-based meat indicate price as the main barrier, while 21% mention taste, 14% mention texture, and 10% cite concerns related to the use of soy or transgenic ingredients, in general. These data reinforce the need to invest in improvements along the soy production chain, from the development of cultivars and processing to the functionality of ingredients in the final formulations.

The findings of the Lamp Project, conducted in 2024 by GFI Brasil, reinforced this assessment and showed that the national industry still depends on the import of ingredients with higher functional performance, due to limited national alternatives. In addition, experts consulted in the study noted the need to better integrate academia and industry, shortening the distance between applied research and its direct industrial applications. Brazilian soy, according to the same experts, not only has the potential to boost the national plant-based market but also to situate it as a global player, exporting added value through plant-based foods produced with high-performance national ingredients, provided that the technological and structural bottlenecks of their value chain are overcome.

In order to guide future research and development initiatives for this strategic ingredient and to foster improved integration between scientific research and market needs, GFI Brasil held a Soy Technical Forum with representatives from academia and industry. Based on these expert contributions, strategic guidelines and research opportunities were defined to enhance soy's potential as a key input in plant-based meat production in Brazil. These guidelines cover the entire production chain, from the development of cultivars with higher protein content and quality, a more complete nutritional profile, and fewer antinutritional compounds, to the final product. Another central point is the adoption of a consumer-centered approach, focusing on accessibility, convenience, healthfulness and valuing the image of soy.

Based on the above, the following guidelines reflect synergistic actions seeking to boost soy use in the formulation of plant-based meat with higher sensory appeal, competitive cost, and improved nutritional value, which are essential elements to drive an inclusive and sustainable transition to alternative proteins.

Identified Strategic Guidelines

The guidelines represent broad paths to guide policies, investments and coordinated actions along the entire soy production chain, from the development of cultivars with an improved protein profile to the formulation of more accessible, healthy and attractive final products for consumers. The identified strategic guidelines are presented and discussed below:

Development of Soy Cultivars for Human Consumption

Currently, most available cultivars were developed to meet the animal feed and biodiesel industry demands, prioritizing productivity, resistance to pests and diseases, agronomic adaptability and oil content, rather than the nutritional quality of the protein. This limits the supply of cultivars focused on meeting the characteristics desired for human consumption. Developing specific cultivars for this purpose would enable the soy production chain to be more strategically aligned with the requirements of the alternative protein sector and the sustainability principles, promoting a chain that is more efficient in the use of natural resources, such as soil and water, by directing production to final foods, reducing intermediate conversion stages, which is how the use of soy is configured to obtain protein for human consumption through the feeding of farmed animals. In addition, this approach would contribute toward strengthening food security and increasing access to nutritious food. Considering this context, fostering genetic improvement programs to develop human consumption-focused cultivars with higher protein content, fewer antinutritional compounds, a more complete amino acid profile, adequate sensory characteristics, and adaptability to local climate is essential and extremely well-suited. This strategic investment has the potential to align the soy chain with the rising demands of the alternative protein market and to support the construction of more resilient, inclusive and sustainable food systems.

Points to consider concerning feasibility and implementation: The adoption of cultivars with high protein content, lower oil content, and optimized sensory traits faces relevant objections from producers. Their lower productivity in relation to traditional cultivars, the additional cost of segregation or adaptation of an exclusive production chain, and the lack of market incentives hinder their introduction into a quite profitable production system dominated by grains already consolidated in the market and that have an extended application to animal feed and biodiesel. In addition, the need for dedicated logistics may compromise the price competitiveness of new cultivars.

Technological Innovation in Processes for Obtaining Soy Ingredients

There are significant opportunities to improve soy protein extraction and modification processes, especially through more efficient and sustainable approaches, such as the use of green solvents and physical, chemical or biological modification techniques. These technologies have the potential to enhance the sensory and functional quality of proteins, contributing toward the development of products with superior texture, taste and nutritional value. Moreover, several of these technological solutions can be adapted to other legumes of interest to the alternative protein market, such as peas, beans and chickpeas, expanding the impact of innovation and strengthening the diversification of plant protein sources in Brazil. However, their industrial-scale adoption requires a comprehensive assessment of economic feasibility. For these solutions to be widely incorporated by the sector, it is essential that they provide not only technological performance gains but also present costs compatible with the context of the national industry, avoiding dependence on high-cost inputs or technological solutions that are not accessible to the national industry. Therefore, the main challenge is to develop processes that reconcile technological innovation and cost competitiveness, enabling the local production of high-performance ingredients for the plant-based meat market.

Points to consider concerning feasibility and implementation: Although emerging protein extraction and modification technologies provide potential functional and sensory quality gains, their large-scale adoption depends on additional factors, such as local technical capacity-building, access to specialized equipment, and regulatory predictability. Moreover, several of these solutions are still in early maturation stages and may require long development cycles until they are ready for commercial use, which should be considered when prioritizing investments.

Expansion and Diversification of Soy-derived Protein Ingredients

Currently, the Brazilian plant-based meat industry relies mostly on isolated and concentrated soy proteins. These ingredients provide high functional quality, such as solubility, emulsification and water-holding capacity, but are often associated with high costs and, in some cases, the need for import. At the same time, defatted soy flour represents a more affordable and widely available alternative in Brazil. However, it still faces relevant limitations both in functional and sensory terms, which compromise its performance in plant-based meat formulations. From a functional point of view, it is necessary to improve properties such as emulsification, water-holding capacity, capacity to form fibrous structures that simulate the texture of animal meat (texturization), and physicochemical stability. The latter refers to the maintenance of integrity during processing, storage and preparation, including shelf life-related aspects, such as resistance to phase separation, oxidation or component degradation. From a sensory point of view, there are persistent challenges, such as aftertaste, undesired color and unsatisfactory performance in different preparation formats. Therefore, making defatted flour more functionally and sensorially adequate constitutes not only a relevant technical challenge but also one of the main opportunities for innovation to expand its use and reduce costs along Brazil's plant-based meat production chain.

Points to consider concerning feasibility and implementation: Diversification of soy-derived protein ingredient formats is essential to improve access and reduce costs; however, it involves relevant technical challenges. Ingredients such as defatted flour, although more accessible and affordable, still exhibit sensory and functional performance that is suboptimal for several applications. This raw material tends to show lower gel strength, more pronounced aftertaste and reduced shelf life, especially due to residual sugars. These factors limit their direct application and must be carefully considered so the research initiative results in solutions with real technical and commercial feasibility. Improving these derivatives requires investments in research and development and adaptation of industrial processes. Replacing isolated and concentrated ingredients with more affordable alternatives may compromise quality traits, requiring a careful balance between final cost and performance.

Strengthening Processing Infrastructure for Innovation and Regional Access

The human consumption-focused soy chain in Brazil still lacks a robust infrastructure for small and medium-scale processing. This limitation impacts the development of innovative ingredients adapted to the specificities of different markets. Expanding the installed capacity, by introducing pilot plants, regional innovation centers, and partnerships between universities, startups, cooperatives and agribusinesses, can boost the production of customized ingredients and facilitate the experimentation and validation of new technologies in a more streamlined manner and connected to local contexts. Investing in infrastructure can also contribute toward cost reduction, since it provides enhanced productive efficiency, better use of raw materials, access to more economical technologies, and resource sharing between different actors in the chain. This approach reduces waste, dilutes fixed costs, and facilitates the entry of new entrepreneurs into the sector. The central idea is to position Brazil as a country capable of developing, adapting and scaling-up solutions in soy-derived

ingredients for application in alternative proteins not only in consolidated industrial centers, but also in strategic and diversified territories. With these advances, it is possible to increase regional competitiveness, foster the rise of innovative solutions, and speed up the creation of high-performance national ingredients that are more aligned with the needs of the alternative protein industry.

Points to consider concerning feasibility and implementation: Introducing pilot plants, regional innovation centers, and institutional partnerships is a promising strategy; however, its success depends on robust coordination with real industry demands. Without a favorable ecosystem that includes incentives, capacity-building, and integration with existing production chains, there is a risk that infrastructure investments will become underutilized or unsustainable in the long run.

Valuing the Image of Soy for Consumers

Although soy is one of the main plant protein sources available in Brazil, it still faces resistance from certain groups of consumers, who still associate it with some negative perceptions, such as a high degree of processing, allergenic potential, environmental impacts related to its large-scale cultivation and the presence of transgenics. These factors represent relevant barriers to their acceptance, especially in plant-based products. To overcome this challenge, developing scientific evidence-based educational communication strategies founded on narratives associating soy with sustainability, health and food security is essential. The promotion of this ingredient should highlight its nutritional density, technological versatility, contribution toward reducing the environmental footprint, and strategic role in promoting a more affordable and balanced diet. Initiatives such as transparency in the production chains, clear labeling, campaigns with credible influencers, and partnerships with research institutions can play a decisive role in positioning soy as an essential and reliable ingredient in transitioning to more sustainable food systems.

Points to consider concerning feasibility and implementation: Reversing the negative perception of soy, associated with factors such as transgenics, environmental impacts, and over-processing, poses a significant challenge. To be effective, communication strategies should be robust, continuous, and based on practical evidence. Still, valuing the image of soy may have a limited impact on certain consumer segments and requires coordination between various actors, including industry, academia, government and civil society.

Consumer-centered Innovation

Considering an approach of actively, systematically and continuously listening to Brazilian consumers' needs, preferences, and restrictions can be strategic to orient food innovation. Understanding not only what consumers want, but also what they can access and value in their daily food consumption tends to increase adherence to new products, especially in the alternative protein market. Factors such as affordable price, convenient purchase, preparation and consumption, healthfulness attributes, and familiar ingredients and formats appear as determinants for the success of innovative foods. As the consumer perception of value is directly associated with the balance between perceived cost and delivered benefits, such as sensory quality, nutritional benefits, practicality and alignment with values such as health and sustainability, basing innovation strategies on the context and diversity of Brazilian consumption could expand access to nutritious food. Positioning the consumer as the center of the innovation process enables driving food inclusion, expanding the reach of plant-based products, and supporting the construction of fairer, healthier and more sustainable food systems.

Points to consider concerning feasibility and implementation: Systematic incorporation of active consumer listening is a valuable strategy, but its practical application may be limited by the companies' deficient structure to conduct continuous research, especially in small and medium-sized enterprises. In addition, consumption insights can vary significantly across regions, social classes, and age groups, which requires segmented and

customized approaches. The attempt to simultaneously meet multiple demands, such as healthfulness, sustainability, practicality and cost, can lead to strategic tensions that hinder the prioritization of solutions.

Research Opportunities

The research opportunities detail technical challenges that require scientific and technological research, focusing on obtaining practical solutions that enable the implementation of some guidelines. These opportunities, which complement and reinforce one another along the soy value chain, include:

Sensory, Nutritional and Functional Optimization of Soy Ingredients

Improving soy ingredients for plant-based products requires an integrated approach that considers functional, sensory, and nutritional aspects. Advances in one of these dimensions often impact the others, and integrated technological solutions have greater potential to provide more competitive products, both in terms of quality and industrial efficiency. Below, the main research opportunities on these fronts are noted, without losing sight of their interrelations.

(i) Functional Optimization: One of the main challenges of the soy-based plant-based food industry is to improve protein ingredient technological performance, such as solubility, emulsification, gelling and water-holding capacity. There are relevant opportunities in research on physical, chemical or biological modification of soy proteins, including methods such as heat treatment, high pressure, extrusion and enzymatic treatment, with the aim of improving these functional properties. For example, improved gelling and water-holding capacity contribute toward obtaining products such as plant-based burgers or meatballs that are juicier and exhibit lower post-cooking weight loss. In turn, improved emulsification capacity helps build a firm and cohesive texture closer to meat products such as sausages, in addition to ensuring that fat and water remain evenly distributed in the product during preparation and consumption. These advances directly impact the texture, structure and stability of plant-based meat, favoring sensory gains and higher efficiency in the production process, such as stability during wet extrusion and better performance in molding equipment.

(ii) Sensory Optimization: Soy sensory profile, especially as to taste, aroma and texture, still represents a barrier to acceptance by several consumers. Research on technologies such as fermentation and the application of specific enzymes has proved promising in reducing *off-flavors* and improving sensory acceptance. In addition to these strategies, the genetic improvement of soy cultivars with a focus on sensory characteristics, such as the reduction of compounds responsible for undesired aftertastes, also represents a complementary and strategic method to increase the attractiveness of the ingredient. Fermented *drop-in* solutions, which can be incorporated directly into existing formulations, provide a practical method to adjust sensory attributes without requiring complex reformulations. Part of these approaches can also provide functional benefits, such as improved stability and texture, and nutritional benefits, by contributing toward reducing antinutritional factors or increasing bioavailability of beneficial compounds, reinforcing the potential for synergy between the different optimization approaches.

(iii) Nutritional optimization: There is also a relevant space for innovation in nutritional terms. Studies that seek to enrich soy ingredients with micronutrients, improve the profile of essential amino acids, reduce anti-nutritional factors and increase the bioavailability of beneficial compounds are key to enhancing the nutritional value of products. Technologies such as fermentation and germination not only enhance the nutritional potential of ingredients but can also improve digestibility and attenuate undesirable sensory attributes, exhibiting a potential for multidimensional impact.

Development of Low-Cost Technological Solutions

The high cost of producing soy-derived products and ingredients still represents an important barrier to expanding plant-based meat. There are opportunities for research on developing technological solutions that improve products' sensory, nutritional and functional characteristics, without compromising the economic viability of production processes. Researches that reconcile performance gains with cost control, efficient input use, simpler technologies with reduced, available and scalable process steps can contribute to cost reduction and make products more affordable and competitive in the market.

Development of Soy Cultivars for Human Consumption

Several soy cultivars available today were developed to meet the demand for animal feed and biodiesel, which may limit their performance for human consumption and the production of plant-based meat. Research on the development of specific cultivars, with high protein content, more balanced amino acid profile, low oil content and more neutral taste and odor, can overcome these obstacles and provide raw materials that are better suited to the technological and nutritional needs required by the alternative protein industry. Further discussions are presented in Strategic Guidelines in the item *Development of soy cultivars for human consumption*, of this report.

Adoption Barrier Survey

Tracing cultural, economic and operational barriers that hinder the adoption of new soy cultivars by the production chain, of innovative technologies by the food industry, and of the use of soy in the human diet is fundamental to guide more effective mitigation strategies. Understanding the factors that limit the incorporation of these innovations, whether in agricultural production, industrial processes or consumption habits, enables developing targeted actions that promote higher market acceptance and share. Further discussions are presented in the strategic guidelines in this report.

Sustainability Benefit Assessment

Redirecting part of soy production, nowadays mostly allocated for animal feed and biodiesel, for direct use in the human diet can provide significant gains in sustainability, by avoiding the losses associated with the process[1] of converting plant proteins and calories into animal equivalents. In 2013, a **study** already indicated that about 40% loss of the calories produced globally by the main agricultural crops of the food system due to the low efficiency in the conversion rates for animals used on a large scale by the livestock sector.

In this context, there can be consideration of research that quantifies the environmental impacts from the consumption of soy-based plant-based meat instead of meat products, such as reduced greenhouse gas emissions and more efficient use of water and soil. Such data is key to strengthening the competitiveness of the category's value chain, especially in markets oriented by ESG criteria.

Research lines that address all these topics in an integrated way, analyzing life cycle, socioeconomic impact and technological development, provide strategic paths to guide public and private investment in science and technology. In addition to enhancing the products' sensory, nutritional and functional quality, these initiatives can favor cost reduction, strengthen the sustainability of the production chain, and expand the acceptance of plant-based meat for different consumer profiles

[1] The conversion rate indicates the animal's efficiency in the process of converting calories and proteins from ingested resources, such as feed, grass and silage, into calories and proteins of the final product (meat).

Behind the Scenes: How This Document Was Built

The presented guidelines were built, and the research opportunities were traced through a quality listening process conducted by GFI Brasil. The goal was to gather relevant technical insights on the main bottlenecks for soy in the plant-based meat chain from experts from academia and industry with extensive experience in strategic areas of the soy value chain, including development of cultivars, fractionation and optimization of plant proteins, research and development of ingredients, extrusion, processing of soy, and production of plant-based meat products. This diversity of technical profiles allowed a comprehensive and multidisciplinary analysis of the challenges and opportunities along the chain. This process comprised the following steps:

1. Structured Technical Form

Prior to holding the forum, GFI Brasil prepared and applied a structured technical form to survey quality insights on the main challenges related to soy-derived ingredients. The questions addressed central issues such as sensory quality, techno-functional properties, processing and economic viability of these ingredients. This step enabled tracing the main critical points of the production chain, from different perspectives of the ecosystem. In total, 38 experts were invited to participate in this phase and 15 accepted, 7 from academia, 4 from the food industry, 3 from the ingredient industry and 1 from the equipment industry. The questions and respective answers are fully available in Appendix 1 of this report.

2. Technical Forum

A virtual meeting was held with the experts to present the form's results and conduct a quality technical dialogue. The discussion enabled validation of the main challenges traced, deepening the consideration of the most recurring issues, and obtaining new insights based on the participants' practical experience. In total, 12 experts accepted to participate in this discussion: 7 from academia, 3 from the ingredient industry and 2 from the food industry.

3. Systematization and analysis of results

After the discussions, GFI Brasil organized and analyzed the contributions received, focusing on tracing the most relevant and recurring bottlenecks. This systematization supported the strategic guidelines and research opportunities presented in this report and served as a technical basis for preparing a *Request for Proposal* (RFP), focusing on optimizing the quality of defatted soy flour for application in plant-based meat.

Final Considerations

In addition to the traced strategic guidelines and research opportunities, the experts' contributions also reinforce the need to consider complementary key elements to strengthen the soy chain geared toward the development of ingredients for the plant-based meat sector. It is important to note that, in addition to technical relevance, innovation proposals should also be assessed from the perspective of commercial viability, adoption risk and impact on the logistics chain to ensure that research investments translate into applicable and economically sustainable solutions. The economic viability and risks of innovations should be central criteria along the entire chain, from research to industrial application, ensuring that the proposed solutions are not only technically effective, but also affordable and viable for the national productive sector.

Prioritizing research for application in the most critical stages of processing, such as extracting oil, obtaining protein and modifying properties, can speed up the development of ingredients with higher functional and sensory value.

In addition, it is important to note the need to coordinate scientific advances with public policy strategies and communication with society. Strengthening government initiatives and economic incentives for the human

consumption-focused soy chain, especially for high-protein and transgenic-free cultivars (an important characteristic so national products and ingredients avoid facing barriers in certain international markets), can significantly increase the impact of the technological solutions developed.

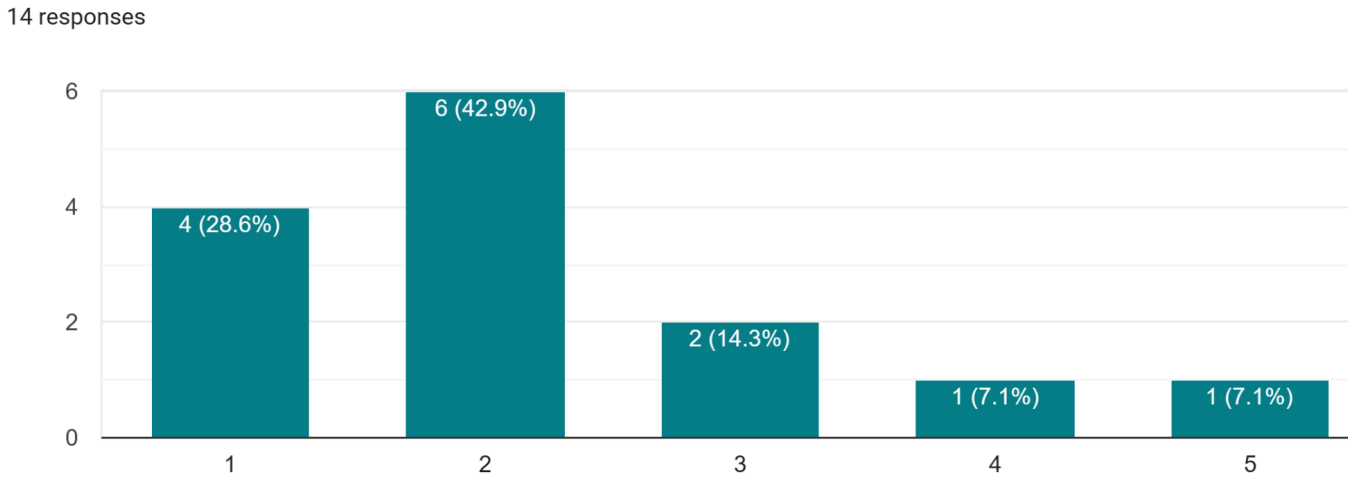
Similarly, research aimed at understanding consumer perception and consolidating scientific evidence on soy can provide valuable inputs to improve the quality of public debate and support data-based communication strategies. These initiatives are fundamental to promoting a valorization of the image of soy as a key ingredient in more diverse diets.

Finally, integrating science, industry and policies to foster innovation is essential to strengthening collaborative environments, speeding up the development of technological solutions, and expanding the commercial-scale use of high-performance national ingredients. These initiatives can consolidate soy as a strategic vector in transitioning to more sustainable, inclusive and resilient food systems.

Appendix 1 - Questions and Answers (Q&A) Form

Part I: Validation of some assumptions about the soy market and production in Brazil

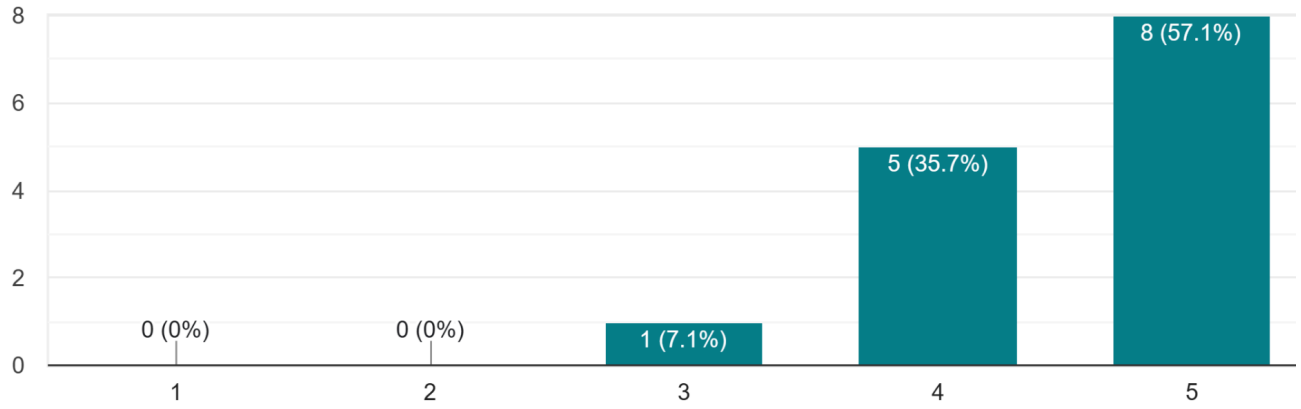
Question 1: On a scale from 1 to 5, indicate your level of agreement with the following statement: “Oil is one of the main soy products with a significant participation in the profitability of the production chain, so cultivars with higher protein contents and lower oil contents are not an economically viable solution for the soy products and derivatives market.”



Where 1 = Totally disagree, 2 = Partially disagree, 3 = Neutral (neither agree nor disagree), 4 = Partially agree, 5 = Totally agree

Question 2: On a scale from 1 to 5, indicate your level of agreement with the following statement: “There is market space and interest for soy cultivars specifically focused on human consumption, with higher protein content.”

14 responses



Where 1 = Totally disagree, 2 = Partially disagree, 3 = Neutral (neither agree nor disagree), 4 = Partially agree, 5 = Totally agree

Question 3: Currently, in Brazil, the availability of non-GMO soy is limited.
To better understand this context, classify the factors that contribute the most to this limitation, classifying them as low, moderate, or high impact.

Factors	Impact (# respondents, %)		
	Low	Moderate	High
Difficulty in ensuring proper handling and transportation to avoid contamination with transgenic grains	1 (8.3%)	3 (25%)	8 (66.7%)
Shortage of dedicated local processing plants and/or that can guarantee non-contamination with transgenic grains	1 (9.1%)	6 (54.5%)	4 (36.4%)
Low level of specialization of domestic producers in the production of non-GMO soybeans	3 (27.3%)	5 (45.5%)	3 (27.3%)
Low cost-related competitiveness compared to transgenic grains	1 (9.1%)	3 (27.3%)	7 (63.6%)
Low quality-related competitiveness compared to transgenic grains	5 (41.7%)	5 (41.7%)	2 (16.7%)

Part II: Technical questions to guide the preparation of the RFP

The answers to the questions below should be directed to finding solutions to improve the quality of soy-based plant-based meat products, focusing on flavor, texture, aroma and price-related competitiveness.

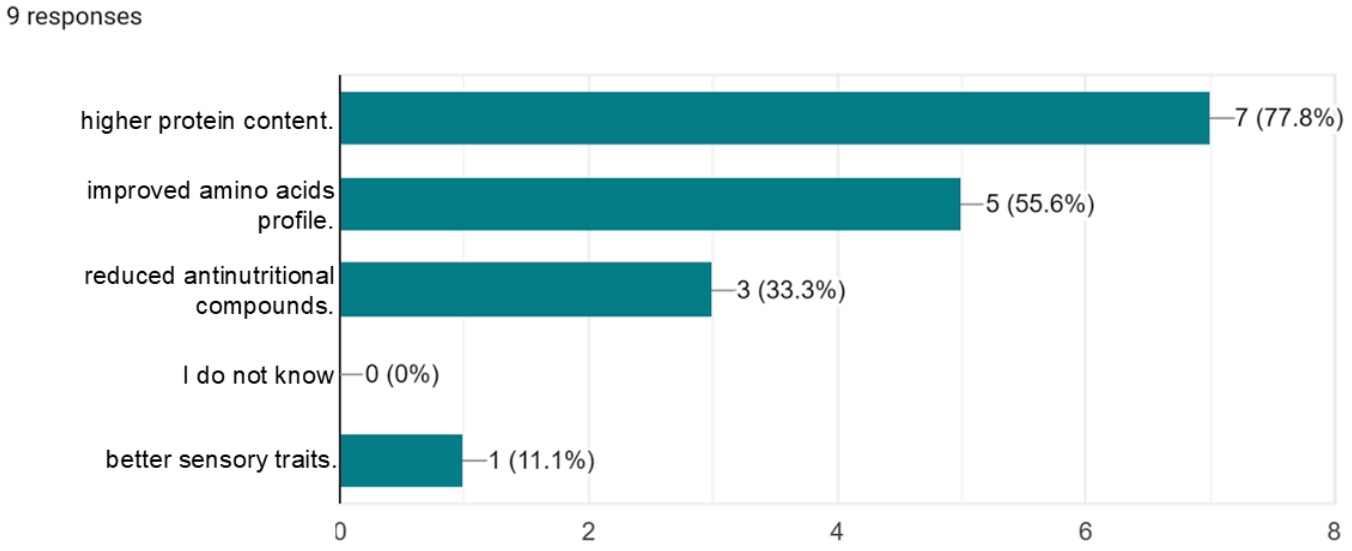
Question 1: Based on your opinion and experience, what are the main **defects and/or limiting aspects** found in plant-based meat products **that correlate with the soy-based ingredients** used in their production? Classify defects and/or limiting aspects as low, medium or high correlation with soy ingredients.

Main defects and/or limiting aspects	Correlation (Number of respondents, %)		
	Low	Medium	High
Off-flavors and taste (taste and odor) during ingestion	1 (7.7%)	4 (30.8%)	8 (61.5%)
Aftertaste (residual taste or sensation after ingestion)	1 (7.7%)	6 (46.2%)	6 (46.2%)
Color before cooking	5 (38.5%)	5 (38.5%)	3 (23.1%)
Color after cooking	4 (30.8%)	7 (58.8%)	2 (15.4%)
Product texture before cooking	3 (23.1%)	6 (46.2%)	4 (30.8%)
Product texture after cooking	3 (23.1%)	5 (38.5%)	5 (38.5%)
High cost	7 (50%)	3 (21.4%)	4 (28.6%)

Question 2: Classify the **production chain steps and processes** according to their **impact on the quality of soy-based protein ingredients** used in plant-based meat products. Number the steps/processes as having low, medium or high impact on the quality of soy-based protein ingredients.

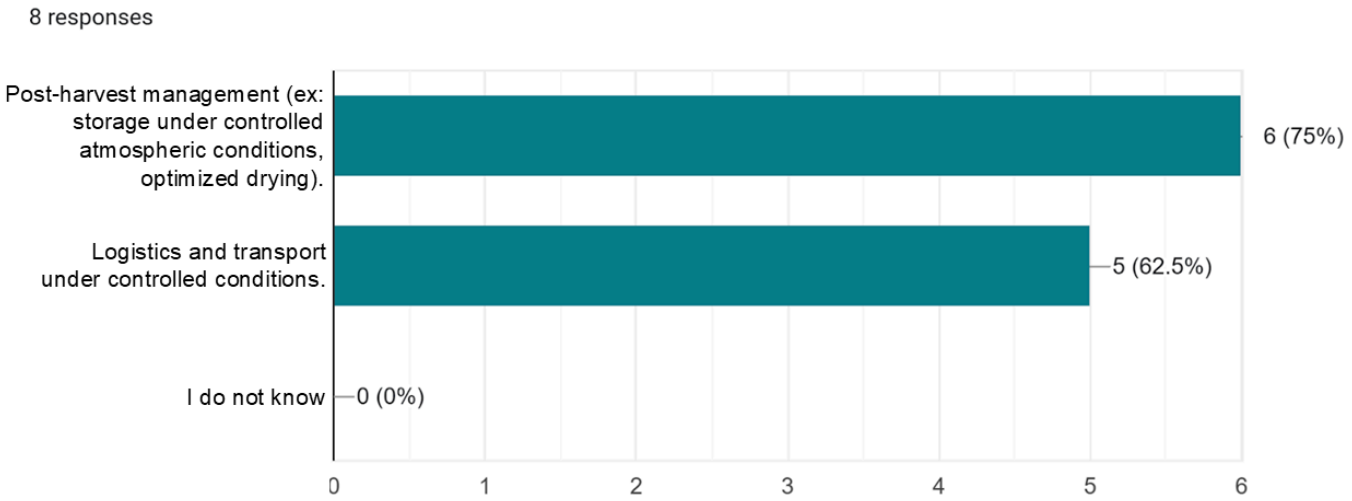
Production chain steps and processes	Impact (Number of respondents, %)		
	Low	Medium	High
Soybean cultivar development and selection	2 (20%)	2 (20%)	5 (60%)
Agricultural management, harvesting, storage and transport of soy	1 (9.1%)	3 (27.3%)	7 (63.6%)
Oil extraction (obtaining oil and defatted protein flour)	0 (0%)	3 (27.3%)	8 (72.7%)
Obtaining soy protein (concentrated, textured and/or isolated protein) from defatted flour	0 (0%)	1 (7.7%)	12 (92.3%)
Protein modification through physical, chemical and biological processes	0 (0%)	3 (21.4%)	11 (78.6%)

Question 2.1: Within the “Soy cultivar development and selection” step, choose up to two options to complete the following sentence: Genetic improvement technologies focusing on obtaining cultivars with...

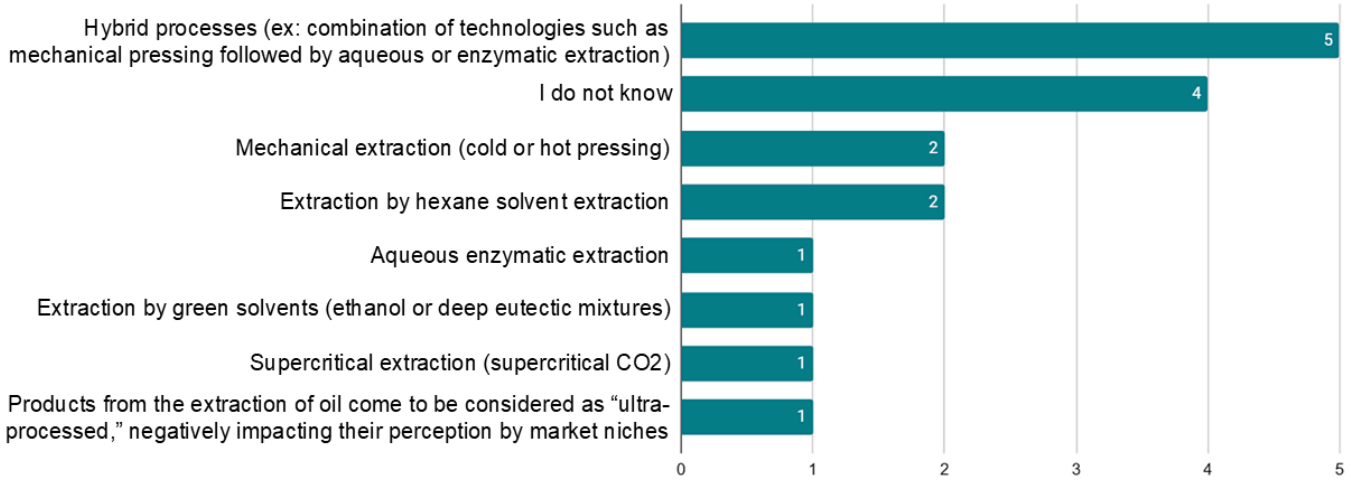


Option added: Better sensory traits

Question 2.2: Within the "Agricultural management, harvesting, storage and transport of soy" step, indicate up to two technologies, processes or approaches that can be explored, through applied research, to improve the quality of soy-based protein ingredients used in the production of plant-based meat products.

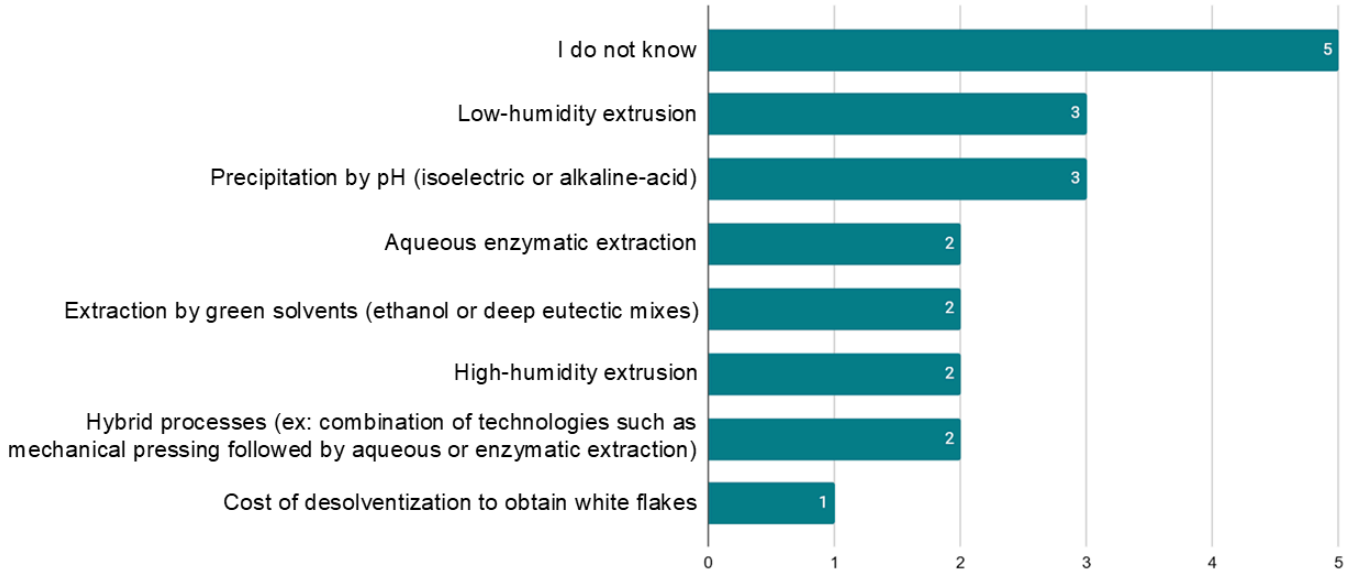


Question 2.3: Within the "Oil extraction (obtaining oil and defatted protein flour)" step, indicate up to two technologies, processes or approaches that can be explored, through applied research, to improve the quality of soy-based protein ingredients used in the production of plant-based meat products.



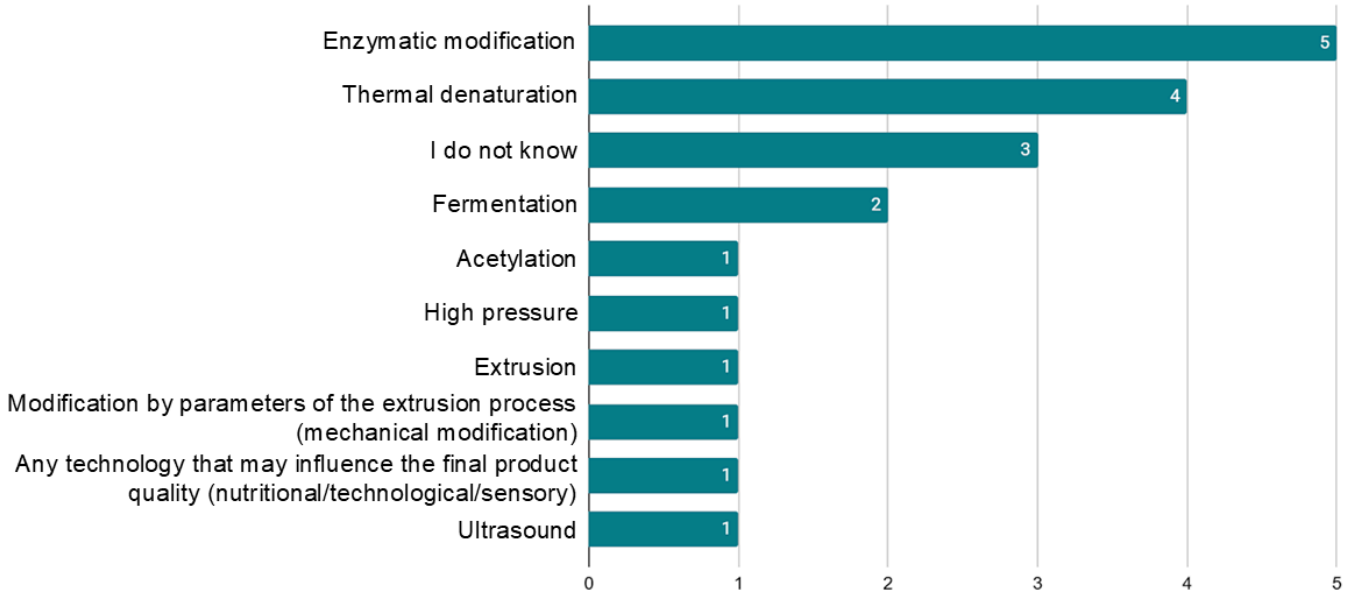
Option added: Oil-extraction products are now considered "ultra-processed," displeasing different niche markets

Question 2.4: Within the "Obtaining soy protein (textured, concentrated and/or isolated protein) from defatted flour" step, indicate up to two technologies, processes or approaches that can be explored, through applied research, to improve the quality of soy-based protein ingredients used in the production of plant-based meat products.



Option added: Cost of desolventization to obtain white flakes

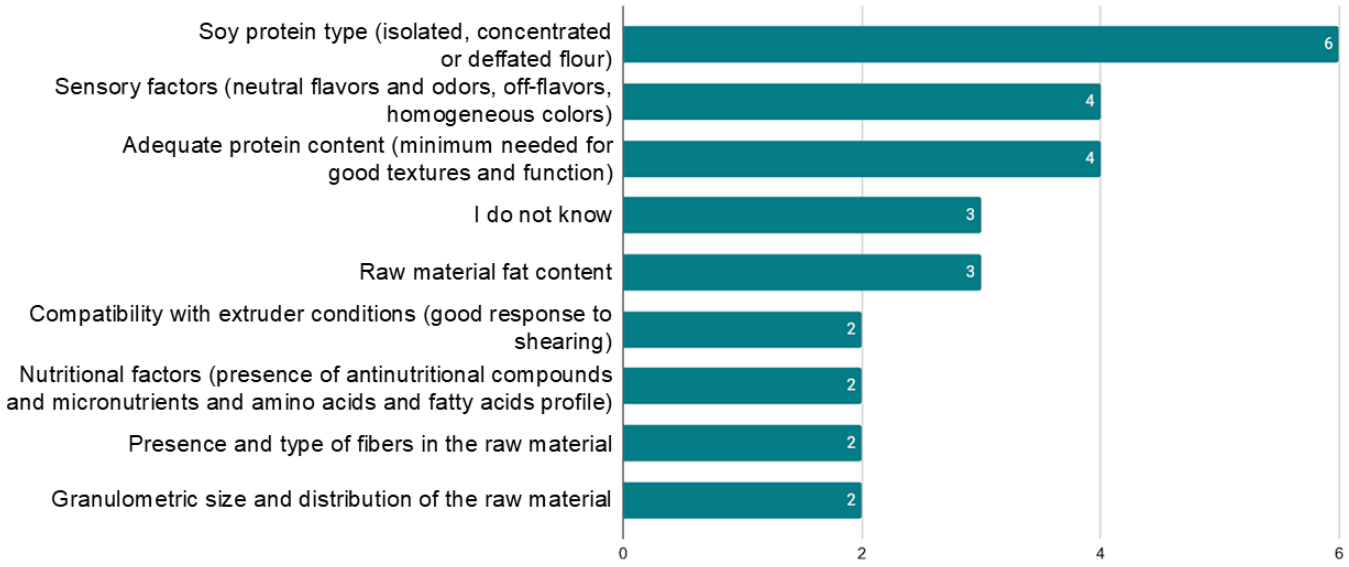
Question 2.5: Within the "Protein modification through physical, chemical and biological processes" step as high impact, choose up to 2 options as instructed:



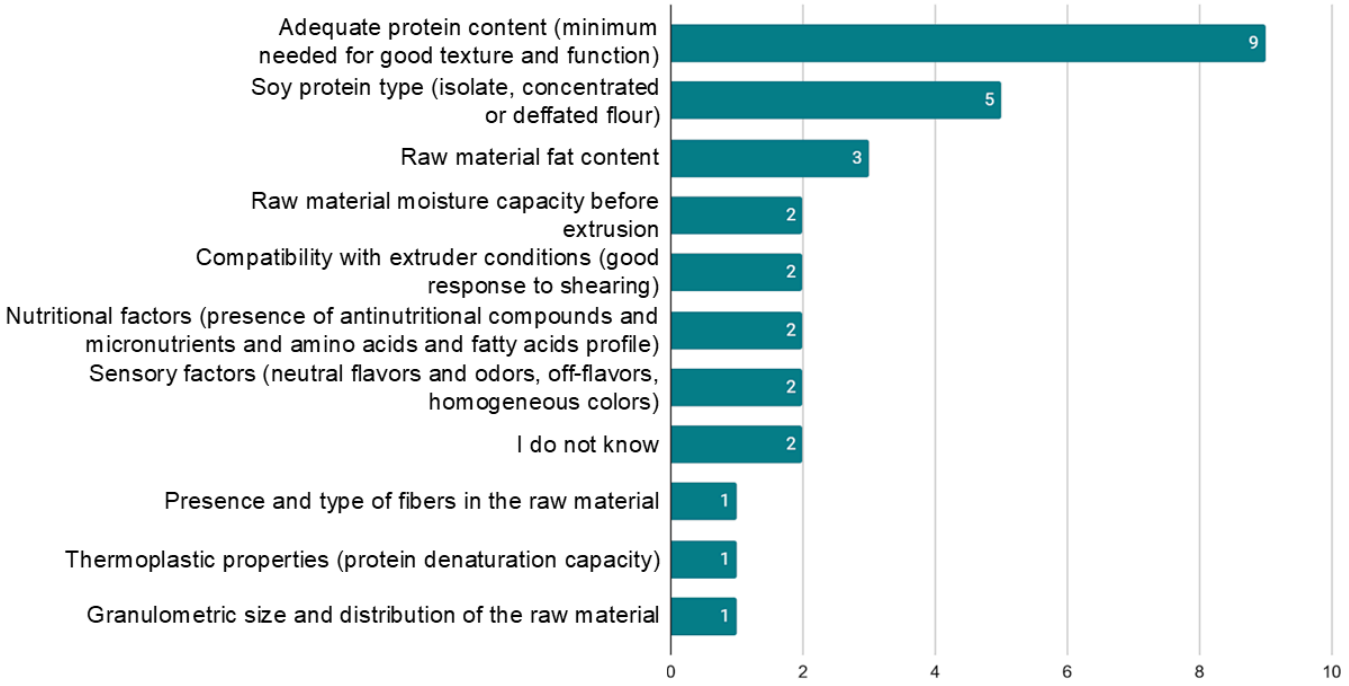
Options added:

- Any technology that may influence the quality (nutritional / technological / sensory quality of the final product);
- Extrusion;
- Modification by extrusion process parameters (mechanical modification)

Question 3: According to your experience, what are the most important controls to be adopted for the raw material (soy protein ingredient) used in the **low-moisture extrusion process for the production of textured vegetable protein (TVP)**? Select up to three options:



Question 4: According to your experience, what are the most important controls to be adopted for the raw material (soy protein ingredient) used in the **high-moisture extrusion process for the development of shredded and whole-cut plant-based meat products?** Select up to three options:

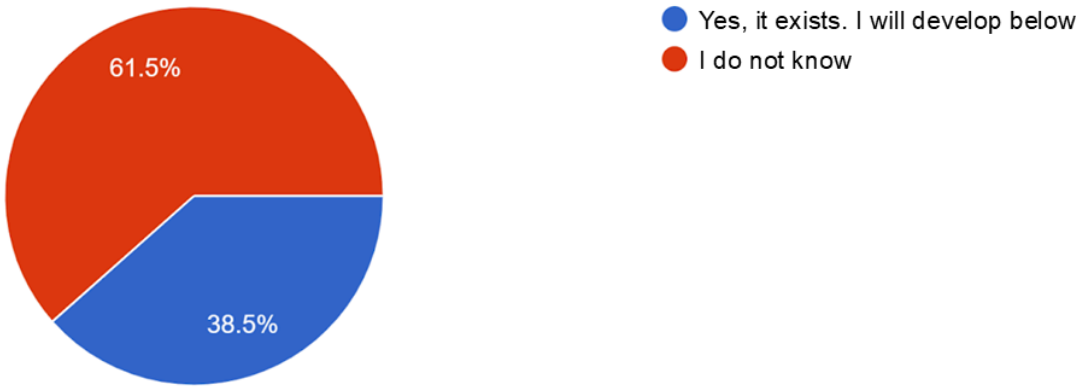


Question 5: Classify the issues according to the degree of priority to direct future research. For the answer, consider: (1) The potential to improve the quality of the final product; (2) The best cost-benefit ratio and; (3) Feasibility of implementation in the installed production infrastructure. Number the issues as low, medium and high priority.

Issue	Degree of Priority for future research (Number of respondents, %)		
	Low	Medium	High
Improvement of the quality of defatted soy flour	2 (16.7%)	2 (16.7%)	8 (66.7%)
Improvement of the quality of soy protein concentrate and/or isolate	1 (8.3%)	2 (16.7%)	9 (75%)
Optimization of dry or wet extrusion technology	1 (7.7%)	4 (30.8%)	8 (61.5%)
Improvement of the production process of the final product and optimization of the balancing of formulations	3 (23.1%)	3 (23.1%)	7 (53.8%)
Use of soy by-products	2 (16.7%)	3 (25%)	7 (58.3%)

Question 6: Is there any process or technology not yet used in the current processes of production and exploration of soy and its by-products that could be important to improve the quality of protein ingredients used in plant-based meat products?

13 responses



If so, what would this process or technology be, and what would its impact be?
Options added:
Fibrillation technology is still little commercially exploited in domestic products.
Protein isolation

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