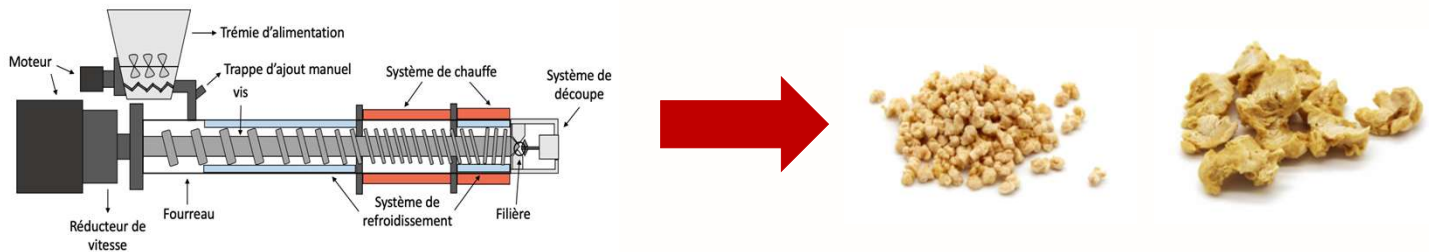


Context

- Producing "meat-like" structures from plant-based proteins to meet the growing demand for sustainable food alternatives is a significant step towards reducing our carbon footprint.
- This approach not only cuts down carbon emissions and the consumption of animal feed but also presents processing challenges.
- As consumers increasingly accept and demand meat analogs, it becomes crucial to improve their texture, appearance, and overall eating experience to match that of real meat.
- Meat analogs, crafted from plant-based ingredients to replicate the fibrous texture, taste, appearance, and nutritional value of animal meats, present an eco-friendly alternative.

⇒ **Twin-screw extrusion processing emerges as a pivotal technology for the continuous production and enhancement of High Moisture Meat Analog (HMEC technology) and texturized vegetable protein products (TVP), ensuring that these alternatives meet consumer expectations**

Texturized Vegetable Protein (TVP)



Production Process and Adaptation:

Most textured vegetable proteins (TVP) are produced via low-moisture extrusion-cooking. Raw materials, screw profile, die design, and operating conditions are optimized to achieve desired quality and properties, including density, water absorption capacity, texture, appearance, and shape.

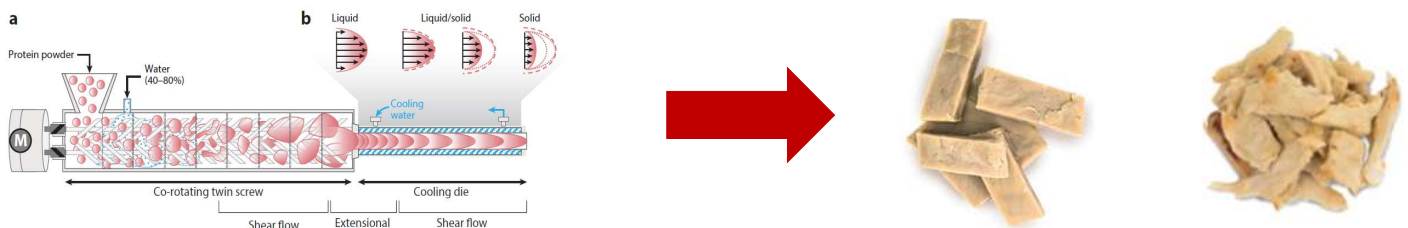
Texture Variations and Forms:

The texture of TVPs can be expanded, fibrous, or spongy. The extrusion process allows for various forms such as chunks, slices, and granules.

Extrusion and Post-Processing:

Dry protein-based ingredients are typically processed at low moisture levels (between 10 and 27%) and cooked in the extruder using a combination of thermal and mechanical energy. TVPs are shaped at the die and cut directly upon exiting the extruder by a granulator. An optional wet milling step can be added to reduce product size. After extrusion, the product is dried to reduce its moisture content to 10% or less.

Fibrated Protein (HMEC)



Xiaonan Sui et al. 2021. Annu. Rev. Food Sci. Technol. 12:119-147

CEMH Technology Overview

CEMH (Cooking Extrusion in a Humid Environment) technology transforms plant or animal proteins into products with meat-like textures. These products can vary in terms of fibrillation, appearance, color, texture, flavor, and size. Fibrous proteins serve as the base ingredient for new finished products, which are nutritionally balanced and can include plant proteins from sources like soy, cereals, or legumes, as well as fish or meat raw materials for human or animal consumption.

Nutritional and Dietary Applications

Fibrous proteins are utilized as ingredients in vegetarian or vegan dishes and can be processed into ready-to-eat meals. Recipes incorporating these proteins are balanced in nutrients and use plant-based ingredients, making them suitable for diverse dietary needs.

Processing and Production

The CEMH technology allows for the continuous transformation of raw food materials with high moisture content (50-80%) into meat-like fibers through controlled and optimized thermo-mechanical processing. The twin-screw extruder mixes and cooks high-protein ingredients under tightly controlled parameters, and the mixture is then transported to a long cooling die, facilitating the formation of protein bonds and a meat-like texture.

Continuous/Longitudinal Fibrillation

Fibrous protein-based products can come in the form of chicken sticks, chicken slices, skewers, boneless pork ribs, sausages, calamari, roast beef, etc.

Discontinuous Fibrillation:

Fibrous protein-based products can come in the form of tuna rillettes, pulled pork, pizza toppings, burgers, nuggets, meatloaf, etc.