

Impossible is possible

Impossible Foods has received funding and support from strong investors

Impossible Foods name to fame has been the successful creation of "plant blood". This liquid makes a meatfree burger not only looking like raw ground beef, but also bleeds on the grill similarly as the all-time American iconic burger. A growing number of select US restaurants now serve these plant meat foods that originate from world's technology hub Silicon Valley in California.

By Henk Hoogenkamp

P lant meat foods are not only the opposite of the misery of industrial animal harvesting, but also to the invisible use of growth hormones, antibiotics, greenhouse gases, chemical fertilizers and clean water. It is estimated that about one-third of the land on planet Earth is used to raise livestock and grow its feed in order to keep the intensive animal production output afloat. All in all, predictions are gaining momentum that plant meat products use about 95% less resources than traditional farm-raised livestock.

Industrial scale feedlot meat production is probably the world's largest environmental problem. Reducing meat consumption will free up vast amounts of land, water and alleviate the suffering of billions of animals. Ultimately, lower commodity costs of plant-origin food, including plant meat products, will contribute to a long stretch of foodprice deflation when compared to the animal meat equivalent.

Flexitarians going forward

Vegetarianism appeals to surprisingly few people – just 2%. The true growth of meat substitutes or plant meat foods comes from flexitarians. This group consciously eliminates or reduces animal meat from their daily line-up of food and plan meatless days a few times each week.

Flexitarians are a rapid growing consumer segment aiming for transformative change, albeit often driven by psychologically inclined aspects associated with animal welfare, health and wellbeing. Also an important variable to consider is the reduction of red meat consumption such as beef and is mainly driven by young girls going through puberty.



Plant meat based burgers are served by selected restaurants like Cockscomb Restaurant, San Francisco, CA.

A challenge to replace

Meat happens to be incredibly tasty and nutritious and perhaps the only way to beat it is to develop a superior plant-based product that is at least equally good in organoleptic performance.

Beef is generally considered the worst part of the meat pyramid because of its inefficient feed-to-meat conversion and the use of huge amounts of clean water during the outgrow cycle of the animal. Not to mention the high amounts of methane gas release in the atmosphere. Yet, on a worldwide basis, more than 50% of all beef is ground and ends up as a hamburger. This is an indication how deeply embedded a hamburger is in many of the world's societal cultures.

The road to concoct a "veggie burger" that is juicy and flavorful with the right texture, bite and chew is quite long and not easy to navigate. Fortunately, with the arrival of cellular agriculture major development hurdles now can be successfully taken and – as a matter of fact – assembling certain compounds and ingredients from plants now allow a level playing field when comparing to the legacy animal meat formulated products.

Of course, there are major differences between animal meat and plant meat. Plants typically contain just a few percent of protein, while animal lean meat has an abundance of high quality protein as well a



The Impossible Burger is made from simple things you know, and one we'd like to tell you about - heme. It's a basic building block of life on Earth, including plants. And it's also the "magic ingredient" that makes meat look, cook, and taste gloriously meaty.

Ingredients: Water, Textured Wheat Protein, Coconut Oil, Potato Protein, Natural Flavors, 2% or less of: Leghemoglobin (heme protein), Yeast Extract, Salt, Soy Protein Isolate, Konjac Gum, Xanthan Gum, Thiamin (Vitamin B1), Zinc, Niacin, Vitamin B6, Riboflavin (Vitamin B2), Vitamin B12.

Contains: SOY, WHEAT

A large group of Millennials is interested in detailed information about their food.



superior mineral content. These differences need to be brought in-line and harmonized.

Another major difference is the flavor and aroma of meat and this is especially true for beef. When beef is cooked, literally hundreds of different subtle aroma compounds come through and together create the ultimate taste humans prefer and are the reference standard for plant meat comparison.

Even when plant meat foods reach a high degree of flavor, aroma and texture equivalency, still one major component is missing from the typical attributes of the burger: "blood". Of course, there is no real blood in raw meat but rather a combination of myoglobin and some extracellular water that creates the reddish looking meat juices.

Progress

Fortunately, the rapid progress of cellular biotechnology now allow scientists to recreate meat hemoglobin analog – an heme-group (iron) containing protein. When "infused" with oxygen, the iron compound

turns red and that is exactly what separates "red meat" like beef and "white meat" like chicken, turkey and to a lesser degree pork.

Not only animals have proteins with a hemoglobin-like function; it appears that some legumes such as the soy plant and alfalfa have nitrogen-fixing properties that can create leghemoglobin (a heme protein). Leghemoglobin - a hemoglobin-like red pigment - is a nitrogen or oxygen carrier found in the nitrogenfixing roots nodules of leguminous plants. Isolating a specific sequence of soy DNA and subsequently inserting it into a yeast strain makes it usable for other purposes. It is well known that yeasts are the modern workhorses of cellular biotechnology and increasingly used in a plethora of foods and beverages, including alcohol, craft beer, animalfree rennet for cheese making, pharmaceuticals and modification or manipulation of many types of protein. These modulated yeasts play also an important role to make "plant blood" by means of fermentation.

A rather traditional step of the fermentation process is used to complete the production of the purified heme in which most of the yeast is removed. It can be debated that this method of heme technology skirts the process of genetically modified organisms (GMO) and it remains to be seen how the natural food purists will react when they have the option in purchasing these plant meat foods. However, it also does not deserve to be pitched as a choice for the lesser of the two evils. When moving forward with such technological advances, it is imperative to find and social, economical, sustainable and ethical equipoise.

Building the burger

Not only the presence of plant hemo protein in a burger, also simulating meat trimmings – including connective tissue and collagen – and animal fat are important variables that contribute to the typical hamburger makeup. The development and creation of a connective tissue matrix in which the plant meat fibrous structured is encased has been attempted for many years. The same is true for the development of stable fat emulsions to simulate ground beef fat, or pork flare fat.

Convincing consumers to give up their beloved beef burger remains a challenge. However, there is no doubt that for a large group of Millennials (born 1982 to 2004) and their children, the new plant meat foods are an attractive and welcome healthy choice.

The writer of this article has been involved in quite a few studies creating "sizzling" emulsions, made from milk-, soy- pea- and potato protein or adsorbed plant fats and oils derived from among others soy, coconut, corn, or canola. These stable emulsions are uniquely able to mimic animal fat and even "sizzle" when the burger hits the grill or skillet.



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Wuhua Road, Wuan Town, Yuncheng County, Heze City, Shandong China Tel: +86 530 6831599 Mobile: +86 530 13953056931 Fax: +86 530 6832119 www.yccasing.com Email: info@yccasing.com



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During cooking on a grill a brown crust appears and really firmes up.



Uncooked Impossible Burgers look a bit reddish and somewhat artificially.

After blending of formula ingredients, including the extruded structured plant fibers and final grinding, the matrix is cooled and the composition (almost) duplicates the appearance of a burger entirely made from 80:20 visual lean premium beef.

There is no doubt that the Impossible Burger is getting closer and inching up to simulating the typical McDonald's Quarter Pounder. In its raw state, the Impossible Burger looks a bit reddish and somewhat artificially manufactured with a slightly more finely grained appearance . When cooked (fried) on a grill or skillet with a few drops of oil, it immediately begins to sizzle and some of the coconut oil emulsion oozes out. After a little while, the patty starts to brown upwards from the bottom and begins releasing some of the "plant blood" juices. When the burger is flipped, a brown crust appears and has really firmed up , just like a beef patty. Come to think about it, as the score stands now, the Impossible Burger has reached a plateau of beef patty equivalency. Companies such as McDonald's are currently at a level in which further quality improvements are not feasible, unless they raise the bar and change the format from frozen to fresh beef patties and get rid of the clamshell grill.

When the Impossible Burger is cooked right and dressed with the usual condiments in a bun, it is a great eating experience and truly indistinguishable from the 100% beef burger. In a restaurant setting it can be a different story: there is often an element of "speed-to-plate" as well as the desire to minimize the dark crust formation when cooked at too high grill temperature. The chef's "solution" is to undercook the patty resulting in a raw-looking inside which might be unappealing for many, especially when very reddish and soft texture. Obviously, some more work needs to be done to communicate the proper cooking instructions with the operators of the restaurants as well as consumers who will purchase these products.

Impossible Foods will continue to further refine the organoleptic performance and still have lots of space to grow. The day is approaching rapidly that the plant meat burger will become the product of choice for a new generation of consumers.

The future is here

Plant-based foods that seek to make inroads into the dairy and meat categories are not any longer a fad but rather it signals evidence of a permanent shift of changing the choice of proteins in the center of the plate, or the center of the bun for that matter. To be fair and balanced: there is a looming chance of disconnect between health and environmentally sustainable objectives. It will be of paramount importance to be transparent and find the right balance between possible conflicting goals of minimally processed "natural" foods and cutting edge technologies that utilize cellular biology including the use of specific microorganisms.

Bylines

- Brand owners of plant meat foods find themselves often in temptation when looking how to grow volumes by moving the brand from its core vegetarian customers to the rapidly growing number of flexitarians who are cutting down on meat for health or emotional reasons.
- Companies such as Impossible Foods, Beyond Meat (US), Gardein (Canada) and Quorn (UK) are often "owned" by their core customers and the loyalty these people give their most favorite brand must be equally respected by the brand owners. This is a difficult pathway to navigate and needs careful strategic balancing in order not to upset the original consumer base.
- Impossible Foods has received funding and support from among others Bill Gates, Google Ventures and Khosla Capital.
- Tyson Foods has taken a minority participation in Beyond Meat.

Henk Hoogenkamp

is a protein application specialist and author of books and articles.



Author's address Hoogenkampl@gmail.com