

Meat without slaughter

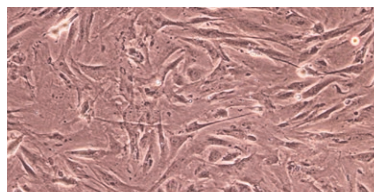
Local start-up Gaia Foods is developing meat products using just muscle and fat cells from cows, lambs and pigs. This does away with the need to slaughter animals for their flesh. Here is how the company does it.

1 TISSUE COLLECTION

• Small tissue samples, each about 0.2g, are collected from young cows, pigs and lambs in Malaysia and Australia.



• Muscle and fat cells are separated from the tissues through a process known as chemical digestion, where enzymes digest other components of the tissue, leaving behind the cells.

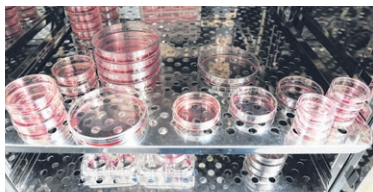


• The cells are multiplied in laboratories abroad, before they are shipped to Singapore in small vials.



2 GROWING CELLS

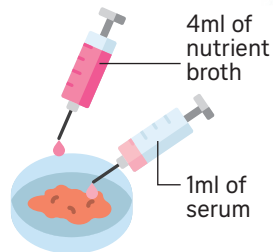
• Cells are placed in petri dishes and housed in an incubator, a controlled environment that mimics the biological conditions of an animal, such as in terms of temperature.



• The cells are nourished with a nutrient broth containing substances such as sugars, vitamins, amino acids and salts. The broth costs about \$300 to \$400 a litre.

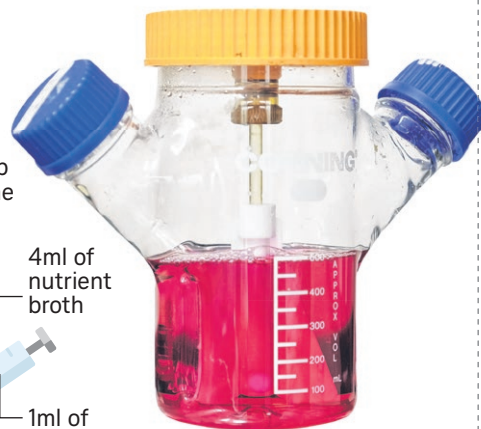
• The cells multiply with the help of growth factors found in bovine serum, which is added to the nutrient broth.

• Bovine serum, harvested from the blood of foetal calves, is currently the most widely used serum for cell culture.



• Not only is it expensive, costing between \$800 and \$1,000 a litre, but also its use in a product that aims to reduce the need to slaughter animals may seem ironic. To replace this, Gaia Foods is planning to produce its own growth factors using plants and yeast.

• The cells growing in petri dishes will be transferred to a 500ml bioreactor (below). Immersed in more nutrient broth and serum, the cells multiply more.



3 CELL HARVEST

• Once the cells reach a sufficient density in the bioreactor, they are harvested.
 • The cells are separated from the broth using different techniques, including spinning the mixture in a centrifuge.
 • The process from growing the cells to harvesting them takes about four to six weeks.
 • At this point, minced meat products such as nuggets and patties can be made. Food ingredients such as flavourings, colouring and bulking agents are added to create the final minced meat product.



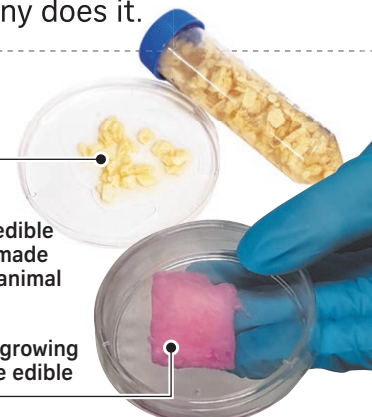
NOTE: Product is for illustrative purposes only, and is not produced by Gaia Foods.

4 CREATING CUTS OF MEAT

• To go beyond minced meat and create textured meat such as steak or pork belly, the cells must grow in and around an edible and porous scaffold, usually made of modified corn, soya or pea protein.
 • The cell paste, grown around a small scaffold (right), is immersed in a different broth that allows the cells to turn into a connective tissue, like a piece of muscle. This takes about two weeks.
 • At the same time, harvested fat cells are also added to the scaffold to turn into tissue. The amount of fat cells added depends on the fat content of a cut of meat.
 • A scaffold used to make steak has to be made of a harder material, compared with one used to make softer meats like pork belly or chicken breast.
 • Gaia Foods will then work with food technology experts and chefs to enhance the meat's texture and flavour, so it is ready to be cooked.

Pieces of edible scaffolds made from non-animal materials.

Beef cells growing around the edible scaffold.



5 STRUCTURED BEEF PROTOTYPE

• In October last year, Gaia Foods created its first structured meat product – six thin pieces of beef that were pan-cooked and served with rice noodles.



The Straits Times tries out three types of alternative meat and rates their taste and resemblance to 'real' meat



Eat Just, Inc's cell-based chicken
 Dish: Chicken nuggets with coconut rice and microgreens

Resemblance:
 Taste:



Vegetarian mock meat, made from soya bean and gluten

Dish: Char siew noodles

Resemblance:
 Taste:

• Canned meat substitutes such as mock duck and abalone are typically made from ingredients such as wheat gluten, beans, mushrooms and tofu.
 • Depending on the source, these foods can be sustainably produced. For example, mushrooms can be farmed in food processing side streams, such as soya bean pulp.
 • For instance, Quorn products are made of a mycoprotein fermented from a natural fungus found in the soil known as the *Fusarium venenatum*. Its carbon footprint is 90 per cent lower than that of beef, and 70 per cent lower than that of chicken.



Impossible meat, a plant-based protein
 Dish: Mushroom Impossible Burger

Resemblance:
 Taste:

• The proteins are made from soya and potatoes, while the flavour of the meat is made from heme, a molecule which gives meat its taste.
 • To replicate the taste of meat, a type of heme protein from plants known as leghemoglobin, found in the roots of legumes, is used to give plant-based meat its flavour.
 • Compared with industrial beef produced in the US, producing the Impossible Burger uses 75 per cent less water, generates 87 per cent less greenhouse gases, and requires 95 per cent less land.