(REVIEW ARTICLE)

Conventional versus Cultured meat

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Abstract

Conventional meat is the edible flesh of animals, usually mammals or birds, but also fish. There are two main categories of meat: white meat and red meat, based on the amount of myoglobin, a protein that gives meat its color. White meat includes chicken, turkey, rabbit, and some fish and seafood, and is generally leaner and lower in cholesterol than red meat. Red meat includes beef, lamb, pork, and venison (gazelle), which is richer in iron, zinc, and vitamin B12, but also higher in saturated fat and calories. The consumption of different types of meat can be good for health as part of a balanced diet because they are excellent sources of multiple nutrients. Including meat can be an excellent way to have a balanced diet. All the different types of meat are highly nutritious and can be healthy. Furthermore, there are many types of meat products, such as sausages, bacon, and salami, that are cured, smoked, dried, or fermented to enhance their flavor and shelf life. On the other hand, Cultured meat involves the production of meat outside of the animal and in vitro. Specifically, cultured meat is produced from animal cells cultured in a growth media in a bioreactor rather than being directly sourced from slaughtered animals.

Keywords: Conventional meat; Cultured meat; Lab-grown Meat; Human health; Environment

1. Introduction

Numerous aspects of the biochemical composition of meat vary in complex ways depending on the species, breed, sex, age, plane of nutrition. Meat is an important source of nutrients for people. It is high in protein with a good balance of amino acids and high in several minerals and vitamins, which play important roles in metabolism and are more easily assimilated from meat than from other foods. The high levels of saturated relative to polyunsaturated fatty acids (PUFA) and of n-6 to n-3 PUFA, especially in the ruminant species, have been criticized by cardiovascular health experts, and this has encouraged animal and meat scientists to search for ways of changing meat fatty acid composition using different feed ingredients. Furthermore, Meat provides essential nutrients and vitamins that aid in muscle and bone strength, brain health, and healthy weight management. Here are some of the health benefits of eating meat: prevents anemia, supports pregnancy, maintains cardiovascular health, as well as balancing cholesterol level, treating rickets, strengthening muscle, providing energy, and maintaining healthy skin [1 - 5].

2. Classification and Interesting Facts of Meat [6 - 8].

2.1. Red meat

A term used for the meat of mammals, which contains higher amounts of iron than chicken or fish. Moreover, meat is rich in various vitamins and minerals as well as protein. Therefore, moderate intake of meat can be recommended as part of a healthy diet. When consumed in moderation, can improve muscle growth. It's also rich in iron and zinc. But

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high consumption of meat has been linked to an increased risk for heart disease. The nutrition facts for a 100-gram serving of ground beef with 10% fat content: calories: 217, water: 61%, protein: 26%, Fat: 10%, minerals: 3%, no

Carbohydrates and no sugar. Furthermore, the following vitamins and minerals are abundant in red meat: -

- Vitamin B12, an essential nutrient that is important for blood formation and human brain and nervous system.
- Zinc, a mineral that is important for body growth and maintenance.
- Selenium, an essential trace element that serves a variety of functions in human body.
- Iron, meat iron is mostly in the heme form.
- Niacin, niacin (vitamin B3) has various important functions in human body. Low niacin intake has been associated with an increased risk of heart disease.
- Vitamin B6, is important for blood formation and energy metabolism.
- Phosphorus, it is essential for body growth and maintenance.
- Beef contains many other vitamins and minerals in lower amounts. Meanwhile, meat contains a number of bioactive substances and antioxidants, which may affect health when consumed in adequate amounts.

2.2. White Meat

White Meat is meat which is pale in color before and after cooking. In traditional gastronomy, white meat includes mainly poultry. Various factors have resulted in debate centering on the definition of white and red meat. Certain types of poultry that are sometimes grouped as white meat are red when raw, such as duck and goose. Some types of fish, such as tuna, sometimes are red when raw and turn white when cooked. The terms white, red, light and dark applied to meat have varied and inconsistent meanings in different contexts. Nutritional studies and social studies popularly define "red meat" as coming from any mammal, and "white meat" coming from birds. The United States Department of Agriculture (USDA) typically classifies red meat, poultry, and seafood as their own separate categories. The USDA considers all livestock animals (including beef, veal, pork) to be "red meat" because their muscles contain enough myoglobin that their fresh meat is deep red in color prior to being cooked. Poultry and seafood are not considered to be red meats because they contain less myoglobin. Dark meat contains 2.64 times more saturated fat than white meat, per gram of protein. For ground-based birds like chicken and turkeys, dark meats occur in the legs, which are used to support the weight of the animals while they move. According to the U.S. Department of Agriculture, 28 grams of boneless, skinless turkey breast contains about one gram of fat, compared with roughly two grams of fat for 28 g of boneless, skinless thigh. The numbers go up when the skin is kept in: a chicken thigh, with skin intact, has 13 grams of total fat and 3.5 grams of saturated fat per 85 g serving; this is about 20 percent of the recommended maximum daily intake. Birds which use their chest muscles for sustained flight (such as geese and ducks) have dark meat throughout their bodies. The health effects that correlate with white meat consumption have been studied as compared to red meat and vegetarian diets. There is a decreased incidence of stroke. There is no association with obesity or insulin resistance. White meat appears to have a neutral or favorable effect on blood coagulation profiles. There is additional evidence that myoglobin promotes carcinogenesis in colorectal models and therefore epidemiologic evidence supports reduced prevalence of colon cancer in those who consume white meat as opposed to red meat. However, poultry includes chicken, duck, goose, ostrich, pigeon, quail and turkey. White meat is better for weight reduction than red meat since it includes fewer fats and calories. Strong myoglobin and iron in the meat muscle fibers give red meat its deeper red color. When cooked, white meat dries up faster than red meat when exposed to high heat. Chapter 3

Therefore, the main categories of conventional meat are:

- Red meat: meat that is dark in color before and after cooking, such as beef, lamb, and goat.
- White meat: meat that is pale in color before and after cooking, such as chicken, turkey, and pork.
- Processed meat: meat that has been preserved by smoking, curing, salting, or adding chemical preservatives, such as bacon, canned meats, sausages, and salami. Many health experts advise limiting the consumption of this Meat.
- Fish: aquatic animals that have fins and gills, such as salmon, tuna, and cod.

2.3. The Most Popular Kinds of Conventional Red Meat [9]

2.3.1. Beef

One of the commonly consumed types of red meat is beef. Beef's different cuts are used for types of steak; hamburgers use ground beef; stews use chunks of Beef. Tenderloin and sirloin are considered most of the meat's tender cuts. When

consumed in moderation, Beef can be very beneficial because it is a rich source of zinc, vitamin B12, and iron. Beef can be a part of a healthy diet. The evidence of health risks is associated with processed meat and not in fatty red meat.

2.3.2. Lamb

The lean cut of lamb is considered one of the healthiest red meat types with high-quality protein and all the essential amino acids. Lamb meat is a cut of meat from a young sheep under a year. Whereas different types of mutton meat are similar to lamb, the only difference is that mutton is meat from adult sheep. Since lambs are usually reared naturally (at pasture, or range), they are considered healthy Meat. The fat content of lamb varies between cuts. Cuts from loin and leg, which are leaner and healthiest cuts of lamb. Compared to the lean cuts with the fat trimmed, the ribs or shoulders, which have significantly more calories.

2.3.3. Goat

Goat meat have less fat than beef but have the same amount of protein, making it one of the healthiest types of red Meat. Therefore, it is best to substitute beef with healthier cuts like a goat is a healthier red meat option. Goat meat is one of the popular meats in Mediterranean, African and middle eastern countries.

2.3.4. Pork

Is one of the world's popular types of meat because of its cheap cost, high protein content, high vitamin B1 and omega-6 fatty acids. However, the myoglobin levels in the meat determine why pork is classified as red meat. The exact nutritional content of pork varies on the type of cut. Eating too many different types of pork cuts might lead to heart disease and high cholesterol because they might contain a lot of fat. It is also necessary to cook pork thoroughly before eating because pork meat is prone to contamination with bacterial pathogens and parasites.

2.4. The Most Popular Kinds of Conventional White Meat [10].

2.4.1. Chicken

Chicken is the most common bird many consume because of its low-fat content. However, different parts of chicken contain different amounts of calories. For example, a wing contains 240 calories, the thigh has 210 calories, and a drumstick has 180 calories in a 3 oz serving. Chicken contains less fat than beef and is a cheaper type of meat, and it has an equal amount of protein as beef.

2.4.2. Turkey

Turkey comes under the white meat category as chicken and is a large poultry bird, but not as popular as chicken. However, it has fewer calories and is slightly darker than chicken. In addition, Turkey is an excellent source of lean protein, whether wings, drumstick or breast and reasonable amounts of B-group vitamins. This nutrient-dense meat is not very costly.

2.4.3. Duck

Duck meat generally refers to the legs and breast of the bird. Therefore, duck is listed as white meat, even though duck meat is darker than turkey or chicken. Peking duck is a popular dish used extensively in Chinese cuisine. Duck meat has many nutrients and is a good source of protein and antioxidants. To remove the saturated fat content of this succulent bird, especially if people are preparing this bird at home, make sure to remove the skin before eating.

2.4.4. Goose

Goose is another white meat that might be difficult to find because it is not one of the most popular types of poultry. However, when skin is removed, the goose meat is rich in protein and low in fat, as it is with most poultry meats. In addition, goose contains plenty of iron, selenium, copper, zinc, potassium, vitamins B6, B12, Riboflavin, and niacin when cooked.

2.4.5. Fish

Lean Fish is much lower in calories than beef or poultry, though they have equivalent protein. Salmon, Herring, Codfish, Redfish, Mackerel, Tuna, Sardine are commercially important ocean fish. Carp, Trout, Whitefish, and Catfish are the major freshwater fish species. For people looking for a healthy form of protein and high levels of Omega-3, Seafood is a perfect option.

2.5. Cultured Meat [11 -18].

Cultured meat (Lab-grown meat) involves the production of meat outside of the animal and in vitro. Specifically, cultured meat is produced from animal cells cultured in a growth medium in a bioreactor rather than being directly sourced from slaughtered animals. Cultured meat is therefore produced in a radically different way compared to conventional livestock methods. The idea of producing meat in vitro has long been advocated by scientists, politicians and artists. This idea is now becoming a technical reality, as cultured meat has just started to be commercialized. Many companies are currently working to develop and bring their product to the market in the coming years. Cultured meat is a technical revolution, but it is also a possible economic and societal revolution, with the potential to disrupt the traditional meat sector. Given that animal agriculture uses more than three-quarters of the world's agricultural land. Cultured meat can readily reshape the world, as it can address several environmental issues, such as air, soil and water pollution posed by traditional agriculture. It can also drastically reduce the risks of emerging infectious diseases, which are principally associated with the storage, production and consumption of animal food. Since cultured meat can be produced indoors during unfavorable external conditions, such as natural disasters, it may lower global food insecurity. And since it is produced under sterile conditions, it can virtually eliminate contamination with disease-causing pathogens. Further, cultured meat does not rely on the exploitation and slaughter of animals, and thus has strong moral implications. Although the potential benefits of cultured meat are considerable, there remain wide uncertainties. Consider, for instance, the argument that this innovation can significantly reduce the cost of producing meat, along with its associated environmental externalities. This argument seems sensible at first: the production of cultured meat does not require all the resources to raise and maintain a farm animal alive. However, there is an opposing argument: muscle development has evolved over millions of years within the body of animals, and producing muscle differently may be costly and inefficient in terms of resource use. Indeed, a large amount of energy is required to produce the ingredients for the growth medium and for running the bioreactor (for temperature control, aeration and the mixing processes). Therefore, there are several differences between cultured meat and conventional meat. Cultured meat is grown in a laboratory from animal cells, while conventional meat comes from slaughtered animals (Figures 1, 2, 3, and 4). Cultured meat has the potential to be more sustainable and ethical than animal meat, as it does not require the killing of animals. Cultured meat involves producing meat from animal cells, not from slaughtered animals. This innovation has the potential to revolutionize the meat industry, with wide implications for the environment, health and animal welfare. The main purpose of this text is to stimulate some economic research on cultured meat. In particular, it includes a prospective discussion on the demand and supply of cultured meat. It also discusses some early results on the environmental impacts of cultured meat, emphasizing the promises (regarding the reduction in land use) but also the uncertainties. It then argues that cultured meat is a moral improvement compared to conventional meat. Finally, it discusses some regulatory issues, and the need for more public support to the innovation. While meat contains some important nutrients, such as B12 vitamin, the overconsumption of red and processed meat, and of other animal products, has been associated with various adverse health outcomes, such as coronary heart disease, type 2 diabetes, obesity, calcium homeostasis, and numerous cancers. It has been recently estimated that an individual should consume no more than 100 g of red meat and no more than 200 g of poultry per week. A high proportion of people in developed countries are currently consuming significantly more than this. Meanwhile, livestock farming contributed negatively to the environmental due to greenhouse gas (GHG) emissions, land and water use, acidification, and eutrophication [19]. Results of research indicated that animal products in the form of meat, aquaculture, eggs, and dairy use about 83% of the world's farmland and contribute about 57% of foods' different emissions, while providing only 37% of world protein and 18% of calories. Although the impact of producing animal products may highly vary, depending on the method of production.

It is nice to mention that the first commercialization of a cultured meat product occurred in December 2020 in a restaurant in Singapore. Two nonprofit organizations, New Harvest, and later, the Good Food Institute, have been key players in supporting the research and development (R&D) of cultured meat. Much of the advanced work in the field has been (and continues to be) conducted within startups. Nowadays, there about 50 startups / companies around cultured meat and seafood. Most startups are currently located in the US and the EU. As discussed, the basic technique used to produce cultured meat builds on tissue engineering, and is not really novel. This technique has largely focused on medical applications, such as regenerative medicine, and non-animal in vitro models used in toxicology and drug development. The production of cultured meat is yet to be scaled up to an industrial level, and it is difficult to know with precision what startups are exactly focusing on. However, the general principles are known. In short, stem cells are taken from muscle tissue or embryos and are first expanded and then differentiated into muscle cells. These cells are further put into a bioreactor where they multiply, and are transferred to a matrix or scaffold to grow into muscle fibers and larger tissue. The growth medium appears to be the critical aspect, in terms of cost and uncertainties.
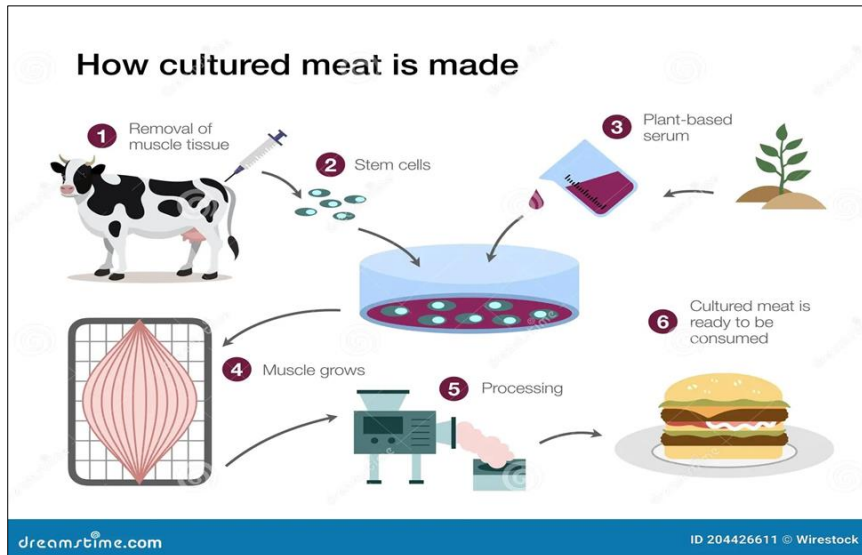
Figure 1 Technique of Producing Cultured Meat

Figure 2 Cultured Meat

Figure 3 Cultured Meat from Cattle

Figure 4 Cultured Meat from Chicken

2.6. Meat and Human Health [20 -24].

Researchers indicated eating too much meat, especially red and processed meat, can damage health. Eating meat can cause several diseases. These include:

- BSE (bovine spongiform encephalitis)
- Trichinosis
- Salmonella
- Foodborne infection
- Foodborne intoxication

In addition, some red meats are high in saturated fat, which raises blood cholesterol and increases the risk of heart disease. Eating meat has also been linked to other health concerns such as type 2 diabetes, cancer, high blood pressure and stroke, Alzheimer's disease, LDL cholesterol, acne, and erectile dysfunction.

Recent evidence from large cohort studies and from meta-analyses of epidemiological studies indicates that the long-term consumption of increasing amounts of red meat and particularly of processed meat is associated with an increased risk of total mortality, cardiovascular disease, colorectal cancer and type 2 diabetes, in both men and women. The association persists after inclusion of known confounding factors, such as age, race, BMI, history, smoking, blood pressure, lipids, physical activity and multiple nutritional parameters in multivariate analysis. The association has not always been noted with red meat, and it has been absent with white meat. There is evidence of several mechanisms for the observed adverse effects that might be involved, however, their individual role is not defined at present. It is concluded that recommendations for the consumption of unprocessed red meat and particularly of processed red meat should be more restrictive than existing recommendations. Restrictive recommendations should not be applied to subjects above about 70 years of age, as the studies quoted herein did not examine this age group, and the inclusion of sufficient protein supply (e. g. in the form of meat) is particularly important in the elderly. Scientific reports showed that eating meat regularly increases a person's risk of developing heart disease, diabetes, pneumonia and other serious illnesses. One study concluded that "On average, people who consuming meat regularly (three or more times per week) had more adverse health behaviors and characteristics than people who consumed meat less regularly. "Higher consumption of unprocessed red and processed meat combined was associated with higher risks of ischaemic heart disease, pneumonia, diverticular disease, colon polyps and diabetes, and higher consumption of poultry meat was associated with higher risks of gastro-oesophageal reflux disease, gastritis and duodenitis, diverticular disease, gallbladder disease and diabetes". Researchers found that every 70 grams of unprocessed red meat and processed meat that a person consumed daily raised their risk of heart disease by 15% and of diabetes by 30% after taking into account other lifestyle factors, such as physical activity and alcohol consumption, and body mass index. Those meats may raise the risk of heart disease because they contain saturated fatty acids, which can increase low-density lipoprotein, or "bad" cholesterol, which is known to put people at greater risk of heart problems. Similarly, every 30 grams of poultry meat eaten daily increased the risk of developing gastro-oesophageal reflux by 17% and of diabetes by 14%, they found. On the other hand, cultured meat is a new production method that raises some health concerns. Unlike conventional meat, cultured muscle cells may be safer, without any adjacent digestive organs. However, with this high level of cell multiplication, some dysregulation is likely as happens in cancer cells. The control of its nutritional composition is still unclear, especially for micronutrients and iron. Some people have expressed concern that cell-cultured meat could pose

unforeseen health risks, and it is unknown whether lab-grown meat will pose any more or fewer safety concerns than traditional meat. Meat consumption can play a role in chronic disease, and the science isn't clear about what impact lab-grown meat could have on nutrition. There are also concerns that genetically-modified cell lines used in cultured meat could exhibit the characteristics of a cancerous cell.

3. Conclusion

It was concluded that "Globally the evidence suggests that people who eat red and processed meat should limit their intake. While it can form part of a healthy diet, eating too much has been linked to increased risk of developing many diseases. Cultured meat can address several environmental issues, such as air, soil and water pollution posed by traditional livestock farming, it can also drastically reduce the risks of emerging infectious diseases.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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