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Popular Article

Meat Alternatives

Namratha Valsalan[1], Vijin V. L.[2], Femi Francis[2]
[1]PhD Scholar*, [2]PhD Scholar, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Pookode, Kerala
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Over the previous forty years, the world's meat production has tripled and increased 20%. Compared to poor countries, developed or industrialized countries consume twice as much. The excessive animal rearing necessary to supply the world's demand for meat negatively affects the entire environment, public health, animal genetic variety, and the general economy. Animal feces releases methane, nitrous oxide, and carbon dioxide, whereas ruminants produce methane through enteric fermentation. Additionally, waste from abattoirs poses a major hazard to the environment and water supplies. Purification and a revolting odor are caused by leftover animal tissues and abattoir blood. The FAO predicts that a severe food scarcity would soon affect the entire planet as the demand for meat will likely rise by more than two-thirds. Alternatives to meat should be created as a strategy, such as cultured meat, proteins derived from plants, and analogues of insect proteins.

The idea of meat substitution is still somewhat hazy, which may have something to do with how it first became necessary to provide proteins and then move on to meat replacement. It is vital to define the vocabulary used to describe meat alternatives. "Meat alternative" is a catch-all phrase that refers to any protein source that can be utilized in place of the meal's meat. The phrase, which is closely connected to "alternative protein," primarily refers to the need to provide proteins and excludes the demands for precisely simulating all the nutritional and textural characteristics. A more accurate name for goods that replicate the functioning of meat in terms of processing, nutritional content, and sensory qualities is "meat analogue" or "meat substitute". Texturized vegetable protein (TVP) technologies and plant biomass are frequently cited as the only structural underpinnings of meat analogues, leading to the idea that these products have advantageous ratios of essential amino acids, little saturated fat, and no cholesterol. Such attribution, however, does not apply to a number of commercially available meat substitutes (insect, microalgae, and other meat-based). As a result, "meat analogue" is defined as a quite broad category of goods that should be further classified into a) insect protein analogues, b) plant-based meat analogues, c) mycoprotein-based substitutes, and d) cultured meat. Typically, the terms "meat analogues" and "meat substitute" are used synonymously to describe physiologically, enzymatically, or physically structured meat imitates made of proteins, lipids, carbohydrates, and other ingredients derived from non-animal sources and uncommon animal species.

History Of Meat Analogues

The use of meat analogue, also known as imitation meat and mimic meat, as a substitute for real meat in food products dates back to the early 1960s. In the past, tofu and tempeh (fermented soybean cake) were made with same ingredient: soy protein. Since 965CE, either these ingredients have been prepared through straightforward processing or fermentation methods, and many Southeast Asian nations have used them for millennia in their traditional cuisine. Along with these traditional Asian goods, dry texturized vegetable protein (TVP), made from extruded defatted soy meal, soy protein concentrates, or wheat gluten, was the first commercialized meat analogue. Early in the twenty-first century, meat substitutes became more popular due to consumer desire for nutritious foods and growing concerns about the environmental impact of consumers' diets. Meat analogue products, which may imitate the flavor, texture, appearance, and functionality of traditional meat-based goods, have been produced in the last ten years thanks to modern advancements in food science and manufacturing technology. Currently, greater attention is being paid to the direct creation of non-traditional protein sources in meat analogues, such as insect protein-based "meat" and cultured meat.

a) Insect Protein Analogues

With 5.5 million different species, insects are one of the most abundant living things on the planet. Nearly 2,000 species of insects are consumed worldwide, primarily in Southeast Asia, South America, and Africa. Eating insects is a long-standing tradition (known as entomophagy) in these areas that dates back at least 3,000 years. As a result of their high protein content and provision of

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important amino acids for our daily needs, insects have long been valued as a source of protein. Coleoptera (beetles), Lepidoptera (caterpillars), Hymenoptera (ants, wasps, and bees), Orthoptera (locusts, grasshoppers, and crickets), Hemiptera (leafhoppers, planthoppers, and cicadas), Isoptera (termites), Odonata (dragonflies), and Diptera (flies) are the orders of insects that are most frequently consumed. However, eating insects is not widely accepted by western consumers, largely due to a poor perception of insects in general and their use in food in particular. Nevertheless, the value of edible insects has become apparent due to the growing demand for proteins other than meat. Insect sales have been rising significantly in recent years, and by 2023, they are anticipated to surpass $522 million in US dollars. Several insects such as grasshoppers, cicadas, leafhoppers, and bugs are rich sources of proteins (20 to 76% of DM), fat (2-20% of DM), low in carbohydrates, and have reasonable amounts of minerals (Na, K and Ca), and trace elements such as Cu, P, Fe, Mn, Se and Zn, water-soluble or lipophilic vitamins such as pantothenic acid and folic acid. Insects are high in proteins containing more protein per 100 g compared to meat, fish, and egg. The wasps, bees, ants have highest protein contents.

The advantages of edible insects extend beyond just their high nutritional value to include their high feed/meat conversion rate as well as their reduced needs for land, water, and feed. Additionally, they require little space and have a high fecundity rate with year-round breeding. Some species (like palm weevil larvae) have a high capacity for recycling since the by-products can be fed to humans or other livestock.

b) Cultured Meat

The newest emerging meat substitute is cultured meat, also known as synthetic meat, lab-grown meat, bio artificial muscle, and Frankenstein meat. It can be characterized as synthetic meat made with stem cell technology. In 1932, former British prime minister Winston Churchill first broached the subject of cultured beef. Techniques for engineering cells and tissues have been created for use in medicine. However, they have recently been used in the realm of food technology for large-scale culturing due to advanced technological inputs. Based on these advancements, the first beef patty made from cow muscle cells was introduced to the general public in 2013. Beet juice and saffron were added to the muscle cells to create the patty, which had the consistency and color of meat.

In order to introduce cultured meat to the market, its production costs must be reduced and its quality standards must be raised. Since cultured meat will be the only true meat that contains animal protein and has a quality comparable to that of traditional meat, it could be crucial in boosting the supply of meat. Major businesses that produce cultured meat include Mosameat, Memphis Meats, Super Meat, and Integriculture. The market size is anticipated to be US $4.3 million for meatballs, US $3.7 million for burgers, and US $3.3 million for sausages, among other varieties of cultured meat that may be introduced.

Benefits as meat substitutes: Since cultured meat is produced from farm animals, it resembles traditional meat the most and may even be more environmentally friendly. Because this product has a superior taste and texture to other meat alternatives, it can satisfy consumers' nutritional and sensory needs. In this regard, cultured beef may appeal to customers who are unwilling to alter their typical diet or meat-eating habits. In addition, a single cell can multiply multiple times during the creation of cultured meat, necessitating the use of fewer animals than in livestock farming.

c) Plant-Based Meat Analogues

They can be produced using plant protein that has been extracted. In fact, one of our species' oldest dietary sources is plant protein. The use of tofu dates back to 965 CE, while other items like wheat gluten, yuba, and tempeh have been around for a long time in various nations and areas. However, compared to typical meat, the majority of them possessed quite distinct characteristics, particularly in terms of flavour and texture. Therefore, it took until the 1900s for these products to become successful on the market. The primary sources of plant-based meat substitutes are known to be wheat, soybeans, legumes, oil seeds, and fungus. Raw materials including soybeans, wheat, and peas (*Pisum sativum*) are processed to produce extracts and isolates that constitute the primary flavourings. These compounds are then put through processes to make items that resemble meat. Many goods, like wheat gluten, yuba, and tempeh, have been utilised for many years in various nations and areas. However, compared to typical meat, the majority of them possessed quite distinct characteristics, particularly in terms of flavour and texture. In terms of flavour and texture, it didn't make for a really enjoyable meal. With rising social expectations, the market for plant-based meat substitutes has recently been growing, and ongoing attempts are being made to enhance their sensory attributes. It currently holds the largest market share among the many meat substitutes, and it is anticipated that the industry would grow to more than $21.2 billion US dollars by 2025.

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d) Fungal Meat Substitutes

The hunt for acceptable, high-protein microbial alternatives has been prompted by worries that animal protein sources won't be enough to satisfy man's protein requirements. They found that filamentous fungi provided a suitably textured product and *Fusarium venenatum* A3/5 was selected as the best fungus for further product development. The continuous-flow fermentation of *F. venenatum* on a glucose substrate yields mycoprotein for commercial use. Cultures are kept at a pH of 6.0 at a temperature of 28 to 30 °C. Normally, the continuous fermentation process lasts for around 6 weeks. Mycotoxins are monitored throughout the production process and tested every 6 hours. In a separate tank, the fungal biomass is heated for 30 to 45 minutes at temperatures over 68 °C (ideally, 72 °C to 74 °C). After centrifuging the heat-treated culture broth, the mycoprotein is extracted as a paste. This paste serves as the base for a variety of foods that can be prepared for human consumption. In order to align the mycelia into a fibrous network with a texture like that of meat, the myco-protein paste and a binding agent (egg albumin) are mixed together during the production of the final goods. Then, using typical food processing technologies, product is formed. Chunks and mince are among the final products, along with sausages, burgers, fillets, and steaks.

F. venenatum myco-protein contains approximately 44% (w/w) protein, on a dry weight basis, and the net protein utilization value is comparable to that of milk. There are all nine necessary amino acids. The amounts of essential amino acids in mycoprotein are roughly equivalent to those found in eggs, despite the fact that the concentration of sulphur-containing amino acids is quite low. Additionally, mycoprotein offers a source of dietary fibre in the form of chitin and glucans from the mycelial walls, is free of cholesterol, and has a low saturated fat content.

Market Prospects

Without a question, as more customers look for sustainable food options and protein substitutes, the popularity of meat alternatives is exploding. Germany, France, the Netherlands, the United Kingdom, Italy, and Sweden are notable leaders in the research and production of meat replacements, with Europe controlling the world market. By 2029, it is expected that plant-based substitutes would increase at a compound annual growth rate (CAGR) of 10%. The market for meat replacements is very competitive since there are so many tiny businesses. Western nations account for the bulk of the industry for plant-based meat substitutes. Food neophobia is the cause of a lesser acceptance of meat alternatives in several Asian nations. The acceptance of novel meals will rise

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over time as customers become more accustomed to the items, since this appears to be the case across all cultures. A poll has been carried out in three well-known nations—the USA, China, and India—to determine whether customers accept beef replacements. Surprisingly, China and India had the highest acceptance rates compared to the United States (74.7%). Healthy diets and concerns about animal welfare and the environment are not the only factors driving the shift away from meat consumption.

Conclusion

It may be said that there is a significant market need for meat analogues in both the present and the future. The consumers interested about nutritious foods and a sustainable environment were the ones that showed the most significant interest in this product, not the rise in vegan consumers. However, there are still few meat alternatives on the market today, and most of what is offered is plant-based. The research and development needed to guarantee meat of a standard of quality required several years. Additionally, due to the availability of resources, alternative meat producers can always manufacture goods based on insects. But the biggest obstacle to be overcame, aside from safety concerns, is acceptability of meat made from insects.

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