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Popular Article

Clean Meat Production: A technique to address plethora of meat issues

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Abstract

Meat as defined by Codex Alimentarius commission is "all parts of an animal that are intended for or/ have been judged as safe and suitable for human consumption". In lay man's word, clean meat is a meat obtained from healthy food animals slaughtered in cleaner premises and free of pathogens; antibiotic residues etc.; and is fit for consumption. Scientifically, clean meat can be defined as a meat obtained from animals without slaughtering procedures. It is developed under laboratory conditions *in vivo* by isolating single animal stem cell. The two techniques very often employed for clean meat production are Scaffold based technique and Self organized technique. Clean meat can help us in addressing the issue of global shortage of meat and fulfill the demands of meat consumers. Ample of benefits are associated with clean meat production that ranges from environmentally friendly outcomes to cost-effective benefits. Also, it would provide healthy, nutritious and sustainable food for future generations that can sustain ever growing global population. Thus, it is a tool that can deal with all matters related to meat production in future.

Key words: clean meat, scaffolds and self-organizing

Introduction

Meat is the flesh of animals which is consumed as a food worldwide (Lawrie *et al*.,2006). It is reported that component inclusive of bones and exclusive of meat is unfit for human consumption (FAO,1994). Kauffman (2001) stated that meat in the broadest sense is the edible postmortem component originating from live animals. Codex Alimentarius commission in the codex of hygiene

practices for meat (2005) defined meat as "all parts of an animal that are intended for or/ have been judged as safe and suitable for human consumption".

From traditional or conventional point of view, clean meat can be defined as meat obtained from healthy food animals which are slaughtered in cleaner premises and free of pathogens; antibiotic residues etc.; and are fit for consumption. As per World Health Organization (WHO), annually 2.2 million persons succumb to death due to food borne illness. According to Global meat & Poultry trends report, published by Research and market dot com, global meat consumption is 313 mMT in 2023 and global per capita meat consumption will increase by 39 Kg per year. There is increasing demand for meat worldwide but it might not be possible to fulfill this demand for meat in future with ongoing traditional forms of meat. Therefore, there is urgent need to find out alternative solution for protein requirement shortly. Clean meat production by in vivo method is one stop solution for adopting an alternative to traditional meat.

What is the clean meat?

The word 'clean' signifies that we can produce meat from animals without slaughtering procedures. Hence, clean meat (lab grown meat, cellular, synthetic meat, agriculture meat, cultured meat) is developed in the laboratory by isolating single animal stem cell under *in vivo* conditions (Srutee, R. *et al*. 2021).

Myogenic and adipogenic stem cells are primarily used for clean meat research (Ben-Arye *et al*, 2019). They can be either replicated to increase the number of identical cells or differentiated into specialized cell types depending on the different stem cells (Roobrouck VD *et al*, 2008). Adult skeletal muscle stem cells are capable of regenerating themselves even outside the body under controlled growth conditions.

Different stem cells are used to produce clean meat and there are three prime criteria:

1. Ability to self-renew for several cell divisions, which is a pre-requisite for sustaining the stem cells pool
2. Ability to generate single cell level differentiated progeny cells of multiple lineages.
3. The ability to functionally reconstitute a given tissue *in vivo*

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1.Embryonic Stem Cells
2.Satellite Cells
3.Totipotent Stem Cells
4. Pluripotent Stem Cells
5. Adult Stem Cells
6.Multipotent Stem Cells
7. Myosatellite Stem Cell
8. Induced Pluripotent Stem Cells

} different potent stem cells used for *in vitro* meat production (Muthuraman P and D.H Kim.,2015; Kadim *et al*.,2015)

The most promising among these cells are myosatellite stem cell. It is the primary adult muscle stem cell (Kadim *et al*.,2015). These cells have been used to cultivate cells to produce the clean meat. Myosatellite stem cells, when cultured in proper nutrient medium and growth conditions, proliferates into myoblasts. These cells, are then differentiate into multinucleated myotubes to form myofibers (Mattick CS et al.,2015)

Preparation of growth medium

Following conditions were required for culturing of myosatellite cells

A) Controlled growth conditions like temeperature, pH and % of CO_2.

B) Basal media contains hydrolysates of yeast, rice, soy, other plants and microbial materials.

C) Supplementary sources such as amino acids, peptides, vitamins and trace elements (Sung YH *et al*.2004).

Proliferation and differentiation of myosatellite cells using three main ingredients, such as Dulbecco's modified medium (DMEM), Fetal bovine serum (20%) and Horse serum (10%). The method was developed by Danoviz and Yablonka-Reuveni successfully.

Techniques of clean meat production

There are two different techniques used for clean meat production.

1) Scaffold based technique

Generally, scaffolds are made from collagen. It provides structural and mechanical support to the cell types ensuring their proper growth and adherence to the flasks. These scaffold materials found in-vitro replicate in natural environment. It helps in proliferation and differentiation of the tissue. It gives a 3D shape and structure to the engineered tissue.

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2) Self- organizing technique

It is one of the promising practices of producing highly structured meat in lab without the use of scaffolds which revealed the same *in vivo* meat

Advantages

1. Clean meat directly produced by culturing a single cell line in bioreactor
2. It reduces harmful effects of the environment
3. It follows animal ethics
4. Free from contamination
5. No need to develop costly vaccines against for dreadful diseases
6. Cheaper

Limitations

1. Cultured meat may damage our relation with nature and animals
2. Because of advancement of technology, direct relationship between man and animals is likely to get complex.

Conclusion

Clean meat (cultured meat) production would provide healthy, nutritious and sustainable food for future generations that can sustain ever growing global population. This technology will be referred to as the future protein that can serve millions of people.

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