

Role of immortalised cells in combating the food crises

Ibrah Bashir

With the advancement in technology, the approach of animal cell culture is finding its way into the agricultural sector. Instead of using whole animals, the technology is being used to create animal products from cell cultures. One of the anticipated products of cellular agriculture is cultured meat, also known as artificial meat or lab-grown meat. According to the OECD agricultural statistics as of 2021, per capita, 42.4 kg retail weight of meat is annually consumed worldwide. It is estimated that this number will rise to 43.7 kg retail weight by 2030. Hence, the development of cultured meat products is a pressing necessity due to the emerging food crises. Though primary cell cultures could be practically used as a starting point for the development of artificial meat products, all cells in primary culture have a finite lifespan, meaning that they reach senescence after a set number of divisions. The senescence is controlled by a set of genes that encode the proteins which negatively regulate the cell cycle's advancement. This limitation of primary cell culture may make large-scale artificial meat production challenging and difficult to achieve. To get over this limitation, finite cell lines can be modified to produce immortalised cells. Immortalisation is a multistep process that can be triggered by knocking down a number of cell cycle regulator genes like retinoblastoma (RB) and tumour suppressor protein p53 (TP53). The RB gene encodes a protein-pRB, which binds to a transcription factor, E2F, and represses the gene transcription. This is an essential requirement for the entry of cells into the S phase from the G1 phase during the cell cycle. The TP53 gene, on the other hand, when activated, causes cell cycle arrest, allowing DNA damage to be repaired or directing cellular senescence or apoptosis. Many methods for inducing immortality in cells have been devised, including the use of viral genes. The expression of the simian vacuolating virus 40 large T (SV40 LT) gene is by far the most successful and widely utilised strategy for obtaining immortal animal cells. T antigen, the result of the SV40 LT gene, is known to bind RB and TP53. It not only allows for a longer proliferative lifespan but also limits the DNA surveillance activity of genes like TP53, resulting in a higher likelihood of creating subsequent immortalising mutations. The safety of consuming immortalised cell lines is one of the most prominent concerns about cultured meat. Another significant problem for scientists is the development of contamination-free cell lines during cell culture. Other difficulties to consider when pursuing cultured meat manufacturing include high production costs, animal welfare concerns, traditional and aesthetic values, and sustaining cell line viability and fidelity. Further research to overcome the aforementioned problems can definitely help in combating the ever-growing food crises.

Keywords: Cellular agriculture, Primary cell culture, Senescence, Apoptosis, Cell cycle, Antigen

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