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# Opportunities for Applying Biomedical Production and Manufacturing Methods to the Development of the Clean Meat Industry

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**Highlights**

- Clean meat is a novel cell culture application with high growth potential.
- Technologies developed for cell-based therapy are highly applicable to clean meat.
- Opportunities to address needs that are unique to clean meat are highlighted.
- Concerted efforts to streamline R&D are needed to accelerate commercialization.

**Abstract**

Clean meat (meat grown in cell culture rather than obtained from animal slaughter) is an emerging biotechnology industry that will ameliorate the serious environmental, sustainability, global public health, and animal welfare concerns of industrial animal agriculture. While many technologies and products developed for the cell therapy industry can already be applied to clean meat, significant opportunities exist to expand product lines to supply this emerging industry. Large-scale cell culture for clean meat production presents a number of unique requirements that are not currently met by existing products and processes from the biomedical industry – most notably related to cost constraints and scale requirements. Developing these tools for clean meat would simultaneously advance the technology and reduce costs for biomedical and therapeutic applications. We will discuss new applications of current biomedical products and manufacturing methods for clean meat, as well as opportunities for synergistic product development through partnerships between academic researchers, established industry players in cell-based therapeutics, and the emerging clean meat industry.

**Keywords:** Clean meat, cultured meat, tissue culture, meat alternatives, cellular agriculture, sustainability

## 1 Introduction: What is clean meat?

Clean meat entails producing the cell types present in meat – muscle cells, fat cells, connective tissue, etc. – through a cell culture platform, using cells derived from meat-relevant species including avian, mammalian, and piscine cell lines. While food applications of animal cell culture have appeared in the literature since the early 2000s [1], in recent years this field has experienced a surge of interest among academics [2–4] and the for-profit sector. In the past two years more than a half-dozen companies have formed to commercialize clean meat, moving this endeavor from the realm of academic inquiry into rapid industrial scale-up and manufacturing. Concerted efforts to achieve