CELL CULTURE MEDIA CONTAINING COMBINATIONS OF PROTEINS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Ser. No. 16/847,337, filed Apr. 13, 2020, which is a continuation of U.S. Ser. No. 15/188,478, filed Jun. 21, 2016, now U.S. Pat. No. 10,618,951, issued Apr. 14, 2020, which is a continuation of U.S. Ser. No. 12/708,462, filed Feb. 18, 2010, now abandoned, which claims the benefit of U.S. provisional patent application No. 61/154,204, filed Feb. 20, 2009, the entire contents of which are incorporated herein by reference.

SEQUENCE LISTING

[0002] The following application contains a sequence listing in computer readable format (CRF), submitted as a text file in ASCII format entitled "SequenceListing," created on Mar. 8, 2021, as 44 KB. The content of the CRF is hereby incorporated by reference.

FIELD OF THE INVENTION

[0003] The present invention relates to cell culture media containing combinations of proteins, as well as methods of making the cell culture media, and methods of using the cell culture media to improve growth characteristics of cultured cells.

BACKGROUND OF THE INVENTION

[0004] Cell culture techniques allow animal or plant cells that are removed from tissues to grow when supplied with the appropriate nutrients and conditions. The cells are capable of dividing and can continue to grow until limited by culture variables such as nutrient depletion or toxic buildup (Butler, M. & Jenkins, H., "Nutritional aspects of growth of animal cells in culture," J of Biotechnol. (1989) 12: 97-110). Cell culture techniques have a number of applications including investigation of the normal physiology or biochemistry of cells (Balaban, B. & Urman, B., "Embryo culture as a diagnostic tool," Reprod. Biomed. Online (2003) 7(6): 671-82), testing the effect of various chemical compounds or drugs on specific cell types (Farkas, D. & Tannenbaum, S. R., "In vitro methods to study chemically-induced hepatotoxicity: a literature review," Curr. Drug Metab. (2005) 6(2): 111-25), studying the sequential or parallel combination of various cell types to generate artificial tissues (Wang et al., "Cartilage tissue engineering with silk scaffolds and human articular chondrocytes," Biomaterials (2006)), and synthesizing valuable biologics from large scale cell cultures (Zeilinger et al., "Three-dimensional co-culture of primary human liver cells in bioreactors for in vitro drug studies: effects of the initial cell quality on the long-term maintenance of hepatocyte-specific functions," Altern. Lab Anim. (2002) 30(5): 525-38). Cell culture techniques have also been used for in vitro fertilization (Blake et al., "Protein supplementation of human IVF culture media," J Assist. Reprod. Genet. (2002) 19(3): 137-43; Bungum et al., "Recombinant human albumin as protein source in culture media used for IVF: a prospective randomized study," Reprod. Biomed. Online (2002) 4(3): 233-6), stem cell research (Conley et al., "Derivation, propagation and differentiation of human embryonic stem cells," Int. J Biochem. Cell Biol. (2004) 36(4): 555-67), vaccine production (Chuang et al., "Pharmaceutical strategies utilizing recombinant human albumin," Pharm. Res. (2002) 19(5): 569-77; GlaxoSmithKline, HAVRIX® (Hepatitis A Vaccine, Inactivated)—Prescribing Information (2005), available at us.gsk.com/products/assets/us_havrix.pdf; Innis et al., "Protection against hepatitis A by an inactivated vaccine," JAMA (1994) 271(17): 1328-34; Merck, PROQUAD®—Measles, Mumps, Rubella, and Varicella (Oka/Merck) Virus Vaccine Live—Prescribing Information (2005), available at www.merck.com/product/usa/pi_circulars/p/proquad/proquad_pi.pdf; Litwin, J., "The growth of Vero cells in suspension as cell-aggregates in serum-free media," Cytotechnology (1992) 10(2): 169-74), tissue engineering including artificial skin (Atala, A., "Future perspectives in reconstructive surgery using tissue engineering," Urol. Clin. North Am. (1999) 26(1): 157-65, ix-x; Sher, et al., "Targeting perlecan in human keratinocytes reveals novel roles for perlecan in epidermal formation," J Biol. Chem. (2006) 281(8): 5178-87) and organs (Neronov et al., "Integrity of endothelium in cryopreserved human cornea," Cryo Letters (2005) 26(2): 131-6; Han, et al., "Interleukin-1 alpha-induced proteolytic activation of metalloproteinase-9 by human skin," Surgery (2005) 138(5): 932-9) and gene and cell therapy (Chadd, H. E. & Chamow, S. M., "Therapeutic antibody expression technology," Curr. Opin. Biotechnol. (2001) 12(2): 188-94).

[0005] Biologics encompass a broad range of cell products, and include specific proteins or viruses that require animal cells for propagation. For example, therapeutic proteins such as monoclonal antibodies can be synthesized in large quantities by growing genetically engineered cells in large-scale cultures (Dewar et al., "Industrial implementation of in vitro production of monoclonal antibodies, Ilar J (2005) 46(3): 307-13). The number of such commercially valuable biologics has increased rapidly over the last decade and has led to the present widespread interest in mammalian cell culture technology (Mizrahi, A., "Biologicals produced from animal cells in culture—an overview," Biotechnol. Adv. (1988) 6(2): 207-20).

[0006] The major advantage of using cell culture for any of the above applications is the consistency and reproducibility of results that can be obtained from using a batch of clonal cells. The need for cell culture, especially at large scale, became apparent with the need for viral vaccines. Major epidemics of polio in the 1940s and 1950s promoted efforts to develop an effective vaccine. In 1949, it was shown that poliovirus could be grown in cultures of human cells, which led to considerable interest in the development of large quantities of the polio vaccine using cell culture (Ligon, B. L., "Thomas Huckle Weller Md.: Nobel Laureate and research pioneer in poliomyelitis, Varicella-zoster virus, cytomegalovirus, rubella, and other infectious diseases," Semin. Pediatr. Infect. Dis. (2002) 13(1): 55-63). The polio vaccine, produced from de-activated virus, became one of the first commercial products of cultured animal cells (Furesz, J., "Developments in the production and quality control of poliovirus vaccines—Historical perspectives," Biologicals (2006)).

[0007] Due to the safety and ethical considerations associated with the use of animal-derived cell culture media components, efforts have been made to provide alternative sources for cell culture media and media components.

[0008] Published PCT Appl. No. WO 2007/002762, which was based on U.S. Provisional Appl. No. 60/694,236, filed