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The Applications of Artificial Proteins and what it means for the future of medicine

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Gerardus Johannes Mulder, a 19th-century chemist, was the first to have coined the term ‘protein’, following his observation concerning the differences in the molecular structures of egg albumin, casein, and other animal structures compared to molecules with similar composition. It was found after years of thorough research conducted by Mulder and his students that showed that the differences between these molecules were due to the presence of single-stranded macromolecules now known as proteins. As noted in Mulder’s 1838 paper, “The plant-feeding animals are thus, considered from this point of view, not different from the flesh-eating” (Mulder, 1838). Although Mulder’s claim may now be looked upon as radical, he surely was onto something. Proteins are made up of a basic structural unit of amino acids, and help regulate and catalyze many of the biochemical processes that occur within our bodies each and every day. Additionally, the study of the chemical and molecular structure of proteins is currently of utmost importance when it comes to replicating proteins to help with the effectiveness of vaccines; understanding the threats of biowarfare; and animal drugs to promote breeding, carcass composition, etc.

So now that we know what an important role protein plays in our normal bodily functions, how might we apply our knowledge of proteins in the real world? Diabetes, one of the leading causes of death around the world, is caused by complications in inadequate insulin production or function. Insulin, a crucial hormone in the body that regulates glucose levels in the bloodstream, is made up of a complex string of amino acids. Problems with insulin whether it be with its function or production are therefore rooted in the hormone’s early stages of production during protein synthesis. An ongoing region of interest in this field is “cell-free protein synthesis”, in which scientists are working towards producing an artificial protein from scratch. The application of the creation of synthetic proteins through such cell-free protein synthesis could revolutionize the treatments for diabetes by creating a more effective synthetic insulin.

Moreover, this field of study is becoming more relevant with ongoing epidemics affecting millions worldwide; whether it be Ebola, Yellow Fever, or smallpox, research into synthetic proteins plays a vital role in the creation of RBDs to boost the effectiveness of vaccines and the overall immunity. The RBD or receptor-binding domain of a virus is located on the protein's surface which is able to bind to the receptor on a cell which then internalizes the receptor. In many cases, like the coronavirus, the immune system is unable to recognize the said virus' RBD and thereby doesn't produce an antibody for that RBD in time. On the other hand, artificial proteins that contain the same RBD spike without the infectious virus may be able to help the immune system ward off the virus in the future through exposure. To look at the idea of developing just a feature of the protein--- the RBD--- scientists study immunogens, an abstract term for any structure that initiates an immune response, and how they might mimic its functional properties. More specifically, this emerging field aims to replicate a non-infectious viral vector, the RBD, to enhance immunogenicity, and the immune response to the viral vector.

However, the development of artificial proteins poses risks that must be carefully considered before moving ahead with such research. The ability to replicate synthetic proteins also comes with the risk of harnessing power at the most essential level. Unrestrained bio development of new pathogens using infectious viral vectors to intoxicate living beings is a serious threat that could lend itself to a new kind of warfare-----bioterrorism. We've seen bioterrorism in the past, from the chemical weapons utilized by the Japanese in WW2 and the rumored Agent Orange rumored to have been weaponized against the Vietnamese in the Vietnam War. With that being said, replicating biology is a herculean task with immense challenges. It is likely that any feature of the human body will never be able to be replicated in a lab to its same energy efficiency and adaptivity. Moving forward, we therefore must place more emphasis on studying the human body and to better stimulate fields such as chemical protein synthesis to understand the limitations of where we should travel with our understanding of the natural world with humanity's shared goal of saving lives.

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