Top 10 ways biotechnology could improve our everyday life

Eurekalert!

Daejeon, Republic of Korea, February 25, 2013—The Global Agenda Council on Biotechnology, one of the global networks under the World Economic Forum (WEF), which is composed of the world's leading experts in the field of biotechnology, announced today that the council has indentified "ten most important biotechnologies" which could help meet rapidly growing demand for energy, food, nutrition, and health. These new technologies, the council said, also have the potential to increase productivity and create new jobs.

The ten technologies were initially proposed at the WEF's Summit on the Global Agenda 2012 held on November 12-14, 2012 in Dubai, the United Arab Emirates, and later confirmed at the World Economic Forum that took place in Davos, Switzerland, on January 23-27, 2013.

"The technologies selected by the members of the Global Agenda Council on Biotechnology represent almost all types of biotechnology. Utilization of waste, personalized medicine, and ocean agriculture are only a few examples of the challenges where biotechnology can offer solutions," said Sang Yup Lee, Chair of the Global Agenda Council on Biotechnology and Distinguished Professor in the Department of Chemical and Biomolecular Engineering at the Korea Advanced Institute of Science and Technology (KAIST). He also added that "the members of the council concluded that regulatory certainty, public perception, and investment are the key enablers for the growth of biotechnology."

These ideas will be further explored during "Biotechnology Week" at the World Economic Forum's Blog from Monday, 25 February, 2013. The full list follows below:

Bio-based sustainable production of chemicals, energy, fuels and materials
Through the last century, human activity has depleted approximately half of the world's reserves of fossil hydrocarbons. These reserves, which took over 600 million years to accumulate, are non-renewable and their extraction, refining and use contribute significantly to human emissions of greenhouse gases and the warming of our planet. In order to sustain human development going forward, a carbon-neutral alternative must be implemented. The key promising technology is biological synthesis; that is, bio-based production of chemicals, fuels and materials from plants that can be re-grown.

Engineering sustainable food production
The continuing increase in our numbers and affluence are posing growing challenges to the ability of humanity to produce adequate food (as well as feed, and now fuel). Although controversial, modern genetic modification of crops has

supported growth in agricultural productivity. In 2011, 16.7 million farmers grew biotechnology-developed crops on almost 400 million acres in 29 countries, 19 of which were developing countries. Properly managed, such crops have the potential to lower both pesticide use and tilling which erodes soil.

Sea-water based bio-processes
Over 70% of the earth surface is covered by seawater, and it is the most abundant water source available on the planet. But we are yet to discover the full potential of it. For example with halliophic bacteria capable of growing in the seawater can be engineered to grow faster and produce useful products including chemicals, fuels and polymeric materials. Ocean agriculture is also a promising technology. It is based on the photosynthetic biomass from the oceans, like macroalgae and microalgae.

Non-resource draining zero waste bio-processing
The sustainable goal of zero waste may become a reality with biotechnology. Waste streams can be processed at bio-refineries and turned into valuable chemicals and fuels, thereby closing the loop of production with no net waste. Advances in biotechnology are now allowing lower cost, less draining inputs to be used, including methane, and waste heat. These advances are simplifying waste streams with the potential to reduce toxicity as well as support their use in other processes, moving society progressively closer to the sustainable goal of zero waste.

Using carbon dioxide as a raw material
Biotechnology is poised to contribute solutions to mitigate the growing threat of rising CO2 levels. Recent advances are rapidly increasing our understanding of how living organisms consume and use CO2. By harnessing the power of these natural biological systems, scientists are engineering a new wave of approaches to convert waste CO2 and C1 molecules into energy, fuels, chemicals, and new materials.

Regenerative medicine
Regenerative medicine has become increasingly important due to both increased longevity and treatment of injury. Tissue engineering based on various bio-materials has been developed to speed up the regenerative medicine. Recently, stem cells, especially the induced pluripotent stem cells (iPS), have provided another great opportunity for regenerative medicine. Combination of tissue engineering and stem cell (including iPS) technologies will allow replacements of damaged or old human organs with functional ones in the near future.

Rapid and precise development and manufacturing of medicine and vaccines
A global pandemic remains one of the most real and serious threats to humanity. Biotechnology has the potential to rapidly identify biological threats, develop and manufacture potential cures. Leading edge biotechnology is now offering the potential to rapidly produce therapeutics and vaccines against virtually any target. These technologies, including messenger therapeutics, targeted immunotherapies, conjugated nanoparticles, and structure-based engineering, have already produced candidates with substantial potential to improve human health globally.

Accurate, fast, cheap, and personalized diagnostics and prognostics
Identification of better targets and combining nanotechnology and information technology it will be possible to develop rapid, accurate, personalized and inexpensive diagnostics and prognostics systems.

Bio-tech improvements to soil and water
Arable land and fresh water are two of the most important, yet limited, resources on earth. Abuse and mis-appropriation have threatened these resources, as the demand on them has increased. Advances in biotechnology have already yielded technologies that can restore the vitality and viability of these resources. A new generation of technologies: bio-remediation, bio-regeneration and bio-augmentation are being developed, offering the potential to not only further restore these resources, but also augment their potential.

Advanced healthcare through genome sequencing
It took more than 13 years and $1.5 billion to sequence the first human genome and today we can sequence a complete human genome in a single day for less than $1,000. When we analyze the roughly 3 billion base pairs in such a sequence we find that we differ from each other in several million of these base pairs. In the vast majority of cases these difference do not cause any issues but in rare cases they cause disease, or susceptibility to disease. Medical research and practice will increasingly be driven by our understanding of such genetic variations together with their phenotypic consequences.

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