Can plant biotechnology help in solving our food and energy shortage in the future?
Editorial overview
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World population has grown from 2 billion during the Second World War to 7 billion in the twenty-first century. The fast growth of the human race creates new problems. In the future we anticipate shortage in water and food supplies. Moreover, the industrial world creates environmental pollution due to heavy usage of fossil-based energy.

An important goal in plant science is to improve the production of food and find new resources for renewable energy. Biotechnology provides new tools for improving food quality, increasing crop yields and finding new resources for energy production.

In the past few years, advances in both our understanding of plant genomes and the functional analysis of key regulators of many physiological processes have been profound. In this issue of Current Opinion in Biotechnology, progress in several selected areas of plant biotechnology has been compiled. On the basis of these, there is no doubt that plant biotechnology will contribute to building a sustainable economy by providing renewable sources of food, feed, energy, and so on, all with a minimum impact on the environment.

Methods for the increase of crop yield have been highly successful in the past years. However, an assurance of food availability does not depend only on the quantity of food but also on its nutritional quality. The nutritional quality of food is a major problem in poor countries. Vitamin A deficiency is estimated to affect approximately one-third of children under the age of five around the world. It is estimated to claim the lives of 670,000 children under five annually. Approximately 500,000 children in developing countries become blind each year owing to vitamin A deficiency. Genetic engineering can tackle the problem of vitamin deficiencies in basic food. In recent years a combinatorial transformation method has been developed which allows the insertion of genes controlling entire biosynthesis pathways into plants. Such developments enable the production of provitamin A in corn and rice plants. The uses of genetic engineering together with conventional breeding allowed the development of crop plants with elevated carotenoid content. However, it is highly unlikely that such crops will be seen in the market due to political issues.

The political dimension of genetically modified crops is usually negative. The media, public, and politicians feed each other with misinformation about the risks of using genetically modified crops. The first review deals with ways to develop plants with improved nutrient content and the environmental safety of these genetically modified plants, as well as the political issues that have been arising with the development of such genetically modified plants [1].

Modifying the biosynthesis pathway of carotenoids may influence other biosynthetic pathways in plants. The metabolic network in plants is very
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complex compared to other organisms. Apart from primary metabolism, plants also synthesize a vast range of specialized metabolites. Primary metabolites include universal building blocks of sugar, amino acids, nucleotides, lipids and energy sources. Secondary metabolites play a key role in maintaining plant fitness. Unlike primary metabolites, absence of secondary metabolites does not result in immediate death, but rather in long-term impairment of the organism’s survivability. Secondary metabolites are often restricted to a narrow set of species and they often play an important role in plant defense. The major secondary metabolite classes produced by plants are: phenolic compounds, terpenoids and alkaloids. In the second paper the regulation between primary metabolism and secondary metabolism in plants is reviewed. Regulations of the expression of genes encoding various metabolism associated transcription factors has shown that similar transcription factors can simultaneously regulate genes involved in the synthesis of primary and secondary metabolites. Identifying such transcription factors will aid in the improvement of various plant traits [2].

In an industrialized world food allergies are a growing concern. The concern of food allergies is not limited to human consumption. There is a growing sensitivity to food allergies in livestock that are being fed with synthetic food. Major plant food sources such as wheat and soybean are cited as a major source for food allergies. Additional plants crops such as peanuts, tree nuts, sesame and sunflower are considered as sources for food allergies. Preventing possibly life-threatening allergic responses is a significant medical issue and critical issue in the food industry. The review in this issue describes ways to identify allergenic proteins. It also describes ways to generate transgenic plants producing allergen-reduced or allergen-null food. The complexity of the allergy issue may influence the approval of new transgenic plants that enter the human food chain [3].

The rapid increases in fossil energy cost have led to increasing interest in alternative energy resources. This issue of Current Opinion in Biotechnology contains two reviews dealing with issues related to food and renewable energy. Vegetable oils consist of energy-dense triacylglycerols that are composed of three fatty acids bound to a glycerol backbone. Vegetable oils are used in preparation margarines, salad oils and fried foods. With the need for new energy sources, triacylglycerols are attractive for biodiesel production. Biotechnology offers a number of solutions to meet the growing need for vegetable oils and vegetable oils with modified composition of fatty acids. Once the critical enzymes in the biosynthetic pathway of oilseeds have been discovered, it opens the avenue for biotechnology to change the amount and composition of vegetable oils. Manipulation of seed oil can be achieved by modifying the amount of different enzymes in the biosynthetic pathway. Metabolic engineering will provide important tools for increasing and modifying fatty acid composition in vegetable oils. Plant biotechnology will provide the tools to generate new crops with modified oil composition in non-food crop plants [4].

The production of renewable fuels from biomass is an evasive goal. Burned wood was used in the past for heating and as a fuel for transportation. Modern society needs to consume energy in the form of liquid or gas. Therefore, we need to develop new ways to produce fuel form plants. Enzymes are being used to deconstruct and ferment the plant cell wall to produce biofuels. However, this process is still inefficient. Analyzing the enzymes that degrade cellulose will open new avenues to create an efficient enzymatic process that can degrade cellulose to produce biofuels. The instant review describes deferent approaches to design enzymes and to screen for improved enzymes that decompose the plant cell wall. These enzymes will enable industrial processes for the production of renewable fuels [5].

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