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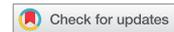
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## COMMENTARY

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# Modern biotechnology breakthroughs to food and agricultural research in developing countries

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**ABSTRACT.** Aesop’s famous fable “Tortoise and Hare” taught us tortoise wins by taking slow, steady approach against its fast, overconfident competitor, hare. I propose tortoise strategy is more beneficial, when comes to public perception and zero tolerance, toward modern biotechnology research and development for sustainable food and agriculture in developing countries.

**KEYWORDS.** agriculture; development; food; modern biotechnology; research

### INTRODUCTION

The continuous increase to the global population, estimated to reach 9 billion people by 2050, poses a serious challenge for global food security achievement. Therefore, the need to feed an increasing world population and to respond adequately to effects of climate change must become a global priority.<sup>1</sup> Modern biotechnological research and development in food and agriculture represent an effective way to address the global challenge of food

security. Biotechnology is the manipulation of living organisms, systems and process for benefit of society, the environment and industry.<sup>2–5</sup> For the future, biotechnology will answer a massive boost in food production to feed that many people. Crops that are more adaptable to varying climate conditions and less vulnerable to pathogens and other pests will be significant pieces of the puzzle.<sup>6</sup> Some developed countries such as the United States and Canada are moving forward in the development and exportation of biotechnological products,

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while most developing countries, such as Turkey, development efforts falter with significant schedule overruns in recent attempts at biotechnology.<sup>7,8</sup> Notably, science holds an esteemed place among citizens and professionals at the developed countries. They recognize the accomplishments of scientists in key fields and, despite considerable dispute about the role of government in other realms, there is broad public support for government investment in scientific research.<sup>9</sup> Countries with transitioning economies in Europe and Central Asia (with exception of Uzbekistan and Turkmenistan) are parties to the Convention of Biological Diversity and most (except the Russian Federation) have ratified the Cartagena Protocol on Biosafety. However, being at very different stages of preparation, adoption, and enforcement of their domestic legislations on modern biotechnology/biosafety and may experience challenges in the implementation of the regulations. The recent accession to the World Trade Organization by a great number of these countries, and the trigger of regional trade integration processes (accession to European and Eurasian Unions) is placing additional challenge in making the national regulations compatible with the relevant international agreements.<sup>10</sup>

In the European Union, the Court of Justice (ECJ) ruled that modern biotechnological organisms obtained by modern forms of mutagenesis such as CRISPR are not exempt from the EU modern biotechnological legislation. Consequently, genome-edited organisms must comply with the strict conditions of the EU legislation. After a decision by the ECJ, many European scientists disagreed the purely process-based interpretation of the legislation by the Court and concluded relevant EU legislation does not correctly reflect the current state of scientific knowledge.<sup>11</sup> Hence, the current approach in the world of modern biotechnology on research and development for food and agriculture is in the midst of change. In addition, the impact of the approach by developed countries on modern biotechnology in other countries has been recognized.<sup>11</sup> This poses the conflicting question on which is the proper course for developing countries in modern

biotechnological research and development on food and agriculture.

### ***PROPER COURSE FOR DEVELOPING COUNTRIES***

On July 10, 2018, Turkey adopted Presidency Decree Law 1, which created a more presidential form of government.<sup>12</sup> Within the scope of the reorganization, the Ministry of Food, Agriculture, and Livestock was re-structured and merged with the Ministry of Forestry and Water Affairs, becoming the Ministry of Agriculture and Forestry. The Presidency Decree Law 1 also established nine presidential policy councils and one of the councils created was the Council of Health and Food Policies, which is responsible for developing biotechnology policies, strategies, and monitoring implementation in Turkey. Subsequently, Biosafety Board in Turkey, which had been active since 2010, was abolished by Presidency Decree Law 703 on July. 9, 2018<sup>13</sup> As of August 2, 2018, the Ministry of Agriculture and Forestry now has the authority to conduct the tasks and responsibilities formally bestowed upon abolished Biosafety Board. Notably, it is the Ministry of Agriculture and Forestry General Directorate of Agricultural Research and Policies that will take over operation of Turkey's Biosafety Law.<sup>14</sup> In Turkey, there are currently 36 approved genetically engineered (GE) soybean and corn traits allowed that for importation for animal feed. The most recent GE traits received approval in August 2017 and 13 applications are currently pending approval. To date, no GE traits have been approved for human food consumption and therefore any GE presence in food products is strictly prohibited in Turkey. For animal feed, there is a 0.9% allowance for low-level presence (LLP) of approved events in feed, but zero tolerance for the detection of unapproved GE traits, and a 0.1% LLP tolerance in feed for GE traits pending approval in the application process.<sup>7</sup>

Aging global food and agricultural technology infrastructure will require replacement beyond 2050; however, new food and agricultural products without modern biotechnology

may no longer be considered a 'sustainable' technology. Given future global food security challenges, modern biotechnology in research and development will greatly enhance efforts to eliminate problems associated with explosive population growth. On the other hand, some people still have fears about large-scale industrial agriculture-related modern biotechnology, and that is why we should also be looking at things from the viewpoint of sustainability.<sup>6</sup> Many people are concerned about concentration and consolidation within the agriculture and food industries and view modern biotechnological products as facilitating that trend. Funding from industry and government for university research is another concern.<sup>15</sup> To prepare for future, the new perspective should implement a new approach to biotechnology research and development, investing in a 'tortoise approach'<sup>16</sup>: an advanced food and agricultural biotechnology program designed to be slow and steady, but to provide multiple technology options. Although there is no guarantee that the use of modern biotechnology will result in a more sustainable food and agricultural system, without a sustained research and development effort that persists through economic and political challenges, most developing countries will most likely forfeit modern biotechnology as a viable food and agriculture option, thus making sustainability goals even more difficult, both for the Turkey and the developing countries. The aim of this approach is not to open a debate on confusing by or frustrating with the modern agricultural biotechnology or the science. It is believed that the modern biotechnological process can be a sound, powerful, and useful modern-day scientific tool. While often depicted as strictly a black-and-white topic – either for or against modern biotechnological products, there is no middle ground – genetic engineering is inherently, and this approach's opinion, neither good nor bad.

Efforts to develop health biotechnology have been ongoing, with recent reviews identifying rare institutions developing advanced concepts.<sup>17</sup> The more aggressive of these efforts are being

developed by institutions following what is referred to as the 'hare approach'—working to rapidly develop their chosen systems and become the first movers in a new age of biotechnological development. Among these institutions in Turkey, Turkish Institute of Biotechnology, an effort funded by Health Institutes of Turkey, is the most important.<sup>18</sup> Though institutions following the hare approach are at various stages of readiness, they do have common attributes. First, most have compressed—and thus riskier—research and development timelines. As a result, these timelines often posit technical maturation rates that exceed estimates of the national scientific research capacity. Second, optimistic research and development and cost expectations by institutions suggest horizons of 10–15 years. While perhaps technically feasible for the most advanced concepts in developed countries, this is most likely not feasible for the countries with economies in transition in Europe and Central Asia, which are more realistically looking at a mid-century window. Finally, "hare" institutions are demanding a more flexible and rapid regulatory regime—something that must still be developed. After this, it would be tremendous news if "hare" health biotechnology companies could achieve a breakthrough and become commercially viable while still addressing challenges noted above. Unfortunately, although some hares may succeed in near-term R&D efforts, most lack the readiness to support rapid, large-scale deployment, and virtually all count on significant governmental support. Because of the aforementioned challenges, this raises significant questions regarding the viability of hare efforts.

Despite the above-referenced challenges for health biotechnology and the current state of research, it will fund food and agricultural modern biotechnology research may follow a 'tortoise approach'. This revised research and development strategy may still boost institutions following the hare approach, but de-emphasizes their near-term temporal goal. A tortoise approach on biotechnological research and development would support a portfolio that would most likely ensure the sustainability of food and agriculture expected to be developed by mid-century. This strategy recognizes the

time requirement for modern biotechnology maturation and ensures a comprehensive approach that addresses all aspects of deployment, including biosafety. In addition, the strategy allows for due diligence in addressing key factors of risk management and public perception that have plagued the acceptance of modern biotechnology in today's world.

### **CONCLUDING REMARKS**

Some critics will note inherent risks that are associated with the tortoise approach to modern biotechnology. These risks include widening of a modern industrial base gap in developing countries and the loss of power of modern biotechnological enhancement by mid-century. Arguably, this is already occurring as other nations move forward in development and export, while national vendors win fewer international commercial contracts, and modern biotechnology research enterprises lag behind. However, consistently funded cutting-edge research efforts would likely forestall any significant degradation in international influence and would mitigate the potential of blindly following modern biotechnology approach of developed countries. Additionally, while the tortoise approach on modern biotechnology is not an internationally focused effort, collaborative approaches should be encouraged. Further, consideration of international teaming should be an option in order to buttress influence until the development effort proposed here bears fruit.

The hare approach to modern biotechnology development efforts creates incentive to move quickly in order to gain first-mover advantage; however, the role of governments is different thus maximizing benefits and minimizing risks. While a tortoise approach to modern biotechnology food and agriculture can best suit for developing countries, including Turkey. If modern biotechnology can meet future food and agricultural production needs, then all the better. Notably, the food and agricultural private sector will provide needed funds for the development and integration of innovative products and projects, which means the requirement of less government investment but by taking a measured

approach, tortoise approach assures that such modern biotechnology is available when needed. Ultimately, modern biotechnology research and development will play a critical role in the global food and agricultural sector and help ensure food security in developing countries with advanced science and genetic engineering throughout the world for the benefit of all people.

### **LAST WORD**

Centuries later, could Aesop, the slave and historian of Ancient Greece, imagine that his stories would portray people and their egocentrism so well nowadays?

### **DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST**

No potential conflicts of interest were disclosed.

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