Unlocking the potential of genome editing

REAZ AHMAD

THE science of genome editing is gaining pace with the world's scientific community having greater grasp of the science, its tools, and its potential applications in deriving products for the immense benefits of mankind. To unlock the potential of genome editing, scientists of the relevant fields in Bangladesh need to take further interest in the frontier science, develop knowledge and skills while the media needs to make the public aware of the new science and its potential through popular writings.

Genome editing, or genome editing with engineered nucleases (GEEN) is a type of genetic engineering in which DNA is inserted, deleted or replaced in the genome of a living organism using engineered nucleases, or 'molecular scissors'.

CRISPR-Cas9 (Clustered regularly interspaced short palindromic repeats-assisted system) is currently the simplest, most versatile and precise method of genetic manipulation and is therefore causing a buzz in the scientific world. The world's leading scientific journal, *Science*, selected CRISPR-Cas9 as 2015's 'Breakthrough of the Year.' CRISPR-Cas9 inventor/s is/are now the most touted candidate/s for the Nobel prize.

Genome is the full complement of genetic information that an individual organism inherits from its parents, especially the set of chromosomes and the genes they carry. This unique technology enables geneticists to edit parts of the genome by removing, silencing, adding or altering sections of the DNA sequence. It has also been used to cure blood disorders like thalassemia and certain cancers.

Jennifer Anne Doudna, Professor of Chemistry, Molecular and Cell Biology of the University of California, Berkeley, has been a leading figure in what is often referred to as the "CRISPR Revolution" for her early fundamental work and ongoing leadership in the development of CRISPR-mediated genome editing. Doudna, along with French microbiology, genetics and biochemistry researcher Emmanuelle Charpentier, were the first to propose in 2012 that CRISPR-Cas9 could be used for programmable gene editing, an idea that has since been further developed by many research groups for applications ranging from fundamental protein research to treatments for diseases including anemia, cystic fibrosis, HIV, etc.

CRISPR-Cas9 system plays the biggest role in research for proving the function of genes. This basic research then leads to applied research and applications. Once the basics of the technology are known, the country's scientists can try out a frontier technology in genome editing.

IMAGE: SCIENTIFIST

For their genome editing contributions, both Doudna and Charpentier were placed in the *Time Magazine's* 100 most influential people in the world in 2015. And this year, both of them bagged the prestigious Japan Prize for their original and outstanding achievements in science and technology, and advancing the frontiers of knowledge. Doudna and her co-writers have just published a paper showing the potential of genome editing in the brain to correct or inactivate the underlying genetic causes of neurological diseases. Genome editing experiments have been carried out in the brain of mice.

CRISPR-Cas9 technology has been used to enhance yield of rice grown in drought conditions and to produce fungal blast resistant rice. For example, scientists from China have reported in the *Journal Frontiers of Plant Sciences* that they have down-regulated the production of abscisic acid (ABA), by cutting a gene responsible for the production of ABA. Lower production of ABA meant that the plant's sensitivity to drought stress was reduced. This has helped increase yield despite the drought condition.

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Some scientists have actively started thinking and acting on using CRISPR-Cas9 system application in their research work. This includes initiatives being taken by the Plant Biotechnology Laboratory at the Department of Biochemistry and Molecular Biology at the University of Dhaka. An international network of scientists, dedicated to the cause of redressing blast attacks in wheat in South America and Bangladesh, are also toying with the idea of applying genome editing so that blast-causing fungi can no longer attack wheat fields. Wheat blast is one of the most fearsome and intractable wheat diseases in recent decades, and the conventional breeding process has so far proven less effective in developing varieties resistant to blast.

Techniques of genome editing in particular CRISPR-Cas9 is also referred to as the 'New Plant Breeding' technology for bringing about necessary genetic changes by using the host genome's own system for systemic incorporation, without having any traces of the vector or transformation marker in the recipients. Therefore in effect, the technology has been deemed similar to genetic mutation which is not subjected to the vigorous oversight that is usual in the case of genetically modified crops. Without the current regulatory oversight, which may take several years, desired crops will be available for use very quickly and thus produce crops which can survive and thrive in the fast-changing climate change scenario. Thus, this is so far the most revolutionary technology of the 21st century impacting plant improvement.

With a goal to expose our scientists to a new world of enormous possibilities, the University Grants Commission (UGC), Krishi Gobeshona Foundation (KGF), University of Dhaka (DU), Faculty of Biological Sciences, DU, National Institute of Biotechnology (NIB) and Bangladesh Council of Scientific and Industrial Research (BCSIR) are helping Global Network of Bangladeshi Biotechnologists (GNOBB) to organise a workshop on CRISPR-Cas9 technology and its application in genome editing later this month. This workshop, organised by GNOBB, is giving the country's scientists a much needed exposure to the highly potential new science. Experts from Japan will be leading this workshop for bench scientists from the agricultural research institutes as well as NIB, BCSIR and public and private universities.

The writer is the Assignment Editor of The Daily Star.

Discrimination laces democracy

BETWEEN THE LINES

KULDIP NAYAR

HOWEVER democratic we may be, discrimination on the basis of caste system has not diminished. Every day, in some part or the other, there are instances of Dalits being burnt alive. Only the other day, Dadri, near Delhi, was the scene of a Dalit family being consigned to fire.

In the national capital itself, a Jawaharlal Nehru University (JNU) student hung himself on March 13 because he could not stand the jibe of discrimination. The 28-year-old M.Phil student had dreamt of studying in JNU and was fortunate to get through on his fourth attempt. Hailing from the South, Muthukrishnan was reportedly a sober personality and generally kept to himself.

Surprisingly, there is very little impact on the society or, for that matter, in India. It was just an incident and forgotten. Instead, the country on the whole should have been shaken. Had this been the case of an upper caste student, there would have been many statements calling for attention notice in Parliament. But there was not even a whisper in the present case.

The media was equally guilty because it reported the incident only as a periphery to some other bigger stories. This only underlined that the media persons, generally belonging to the upper caste, have the same old mindset. The youth is supposed to be radical, but this was not the case.

Obviously, the deceased student's father and even some students believe that there was some foul play. The police was led to record the First Information Report (FIR) under relevant provisions because the police thought that it was a case of suicide. The parents have demanded a Central Bureau of Investigation (CBI) inquiry. I don't know how it would make a difference because the CBI would itself depend on the Delhi Police which is in the dog house.

A similar issue had cropped up when Rohith Vemula, a Dalit research scholar from Hyderabad University, committed suicide last year. However, unlike in the JNU student's death case, there was a big hue and cry, and students took to streets and the agitation even led to the change of guard at the university's department.

Incidentally, Muthukrishnan had recalled Rohith's death and condemned Hyderabad University's alleged role in the Dalit scholar's suicide. The JNU student had a Facebook post in which he had criticised JNU's new admission policy, obviously recounting several instances where he had to face discrimination.

What do these incidents in varsities indicate? We need to apply our minds to address the problems that Dalit students face in institutions of higher education. Not long ago, the Hyderabad University had to revoke the suspension of students after Rohith's death. Indeed, his suicide had caused great shock and resulted in outrage, but similar sentiments were expressed when Senthil Kumar from Salem, another student from the University of Hyderabad, killed himself in 2008. Muthukrishnan, too, is from Salem in Tamil Nadu.

There have been over a dozen cases of suicides by students, mostly Dalits, in various institutions in Hyderabad between 2007 and 2013. In the north, besides two cases of suicide by Dalit students at the All India Institute of Medical Sciences in Delhi, 14 other cases of suicide by Dalit students were reported between January 2007 and April 2011.

It is almost as if we have become immune to these frequent instances of suicide mainly by Dalit students. The student population on campuses of higher education has become increasingly diverse. According to 2008 data, of the total number of students in higher education in the country, four percent of them are Scheduled Tribes, 13.5 percent Scheduled Castes and 35 percent Other Backward Classes. Hindus alone accounted for about 85 percent of students, followed by Muslims (8 percent) and Christians (3 percent). And yet, 23 out of 25 were of Dalits!

There are several research studies which indicate that experiences of discrimination, exclusion and humiliation are the predominant reasons. After analysing some cases of suicide, the conclusion seems to be that there is more than enough evidence to believe that caste discrimination played a significant role in driving these extraordinary individuals into committing suicide, and that elite professional institutions are the places where caste prejudice is so firmly entrenched that it has become normal.

A study in 2010 by Professor Mary Thornton and others of five higher educational institutions in India and the United Kingdom observed that "separation of groups on the higher education campus is pervasive and ubiquitous. While some such separation may be for supportive reasons, at other times it is due to overt discrimination on the grounds of race, region, nationality, caste, class, religion, or gender".

In 2013, Samson Ovichegan, in a study on the experience of Dalits in an elite university in India, observed that "this university is yet another arena in which the practice of caste division continues to exist. The university environment reinforces and maintains a divide between Dalit and non-Dalit. Dalit students do, indeed, experience overt and covert discrimination based on caste at this premier university".

As much as we admit to the persistence of caste discrimination and stigmatisation as a problem plaguing higher education campuses, there is also a constant denial or attributing the suicides to incident-specific situations with total disregard for links with the larger social milieu of exclusion. True, there are incident-specific reasons, but it cannot be a coincidence that out of 25 cases of suicide, 23 were of Dalits. Thus, the first thing for policymakers is to come out of denial mode.

No doubt, the situation may have improved. But the shame of caste system continues in one form or the other. Relations between the Dalit students or, for that matter, with other students and teachers and administrators, have always been questioned. In my view, we need to take steps to address the problems of Dalit or other marginalised students. The only solution I can think of are the legal safeguards against discrimination, civic education and academic assistance to students who need support, and participation of Dalits in all decision-making bodies of universities and colleges.

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The writer is an eminent Indian columnist.

QUOTABLE Quote

HANNAH ARENDT

GERMAN-BORN JEWISH AMERICAN POLITICAL THEORIST

The sad truth is that most evil is done by people who never make up their minds to be good or evil.

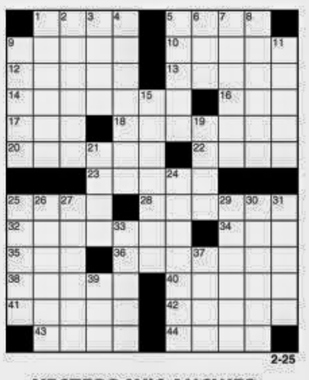
CROSSWORD BY THOMAS JOSEPH

ACROSS

1 Rugged rock
5 Overthrow
9 Stock unit
10 Arm bones
12 Fleet-based
13 Hall of Fame catcher
14 Cave raider of Story
16 Suffering
17 Signing need
18 Sawbuck
20 Wonder of music
22 Towel word
23 Prelude
25 Symbol of grace
28 Admits
32 Lets out early
34 Verb for you
35 Parenthesis, e.g.
36 Sitting on, as a horse
38 Characteristic
40 Did clerical work
41 Reason
42 Manual readers
43 Approach
44 Bulb components

DOWN

1 Home in the Alps
2 Gorge
3 Swift horse
4 Quivering dessert
5 Havana native
6 Pamplona cheer
7 Still green
8 Sitting room
9 Loses it
11 Tars
15 Fireflies, e.g.
19 Bar order
21 Asti export
24 Soothing
25 Petty quarrels
26 Rabbits' home
27 Secret
29 Went to sea
30 Picks an entree
31 Calls for
33 After a while
37 Increase
39 "Rose -- rose ..."



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YESTERDAY'S ANSWER

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BEETLE BAILEY — BY MORT WALKER

BABY BLUES — BY KIRKMAN & SCOTT