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Genome Editing: An advanced tool for targeted mutation in living Organisms

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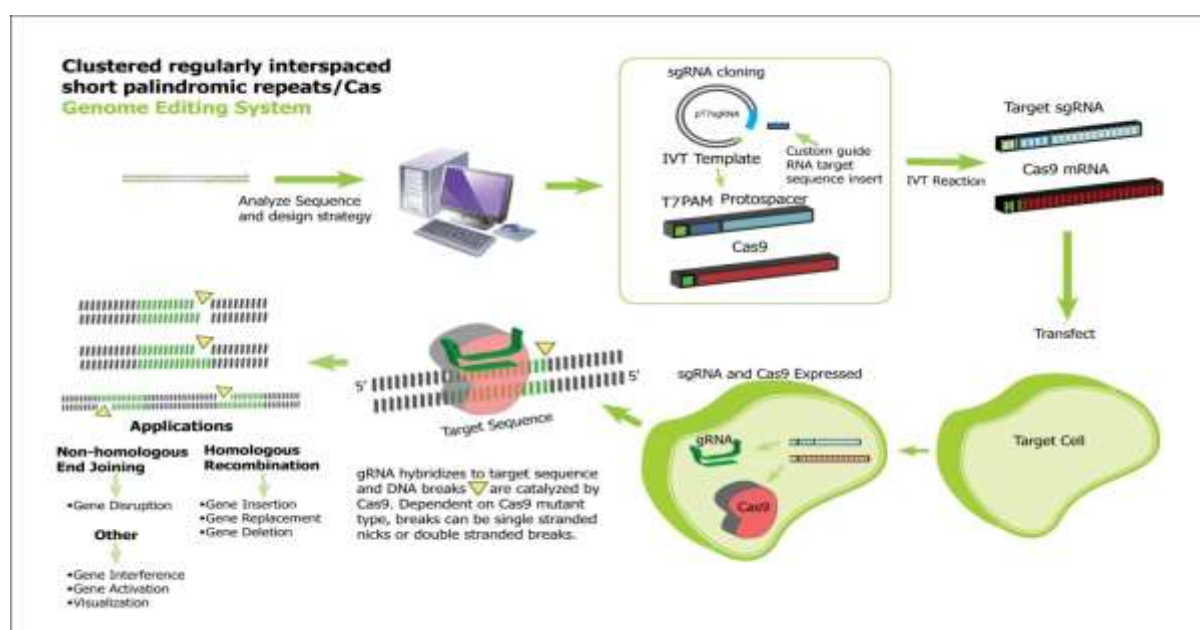
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The living organisms can be genetically altered through Hybridization, Mutation and Genetic engineering to meet desired needs. However, these processes are more random and depends on chance factor compared to targeted engineering tools. Some of the recent technologies are very specific and alter specific nucleotide in the genome. According to Wikipedia (1), 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 living organism using engineered nucleases or molecular scissors. This is a kind of cut-and-paste genetics (2).The major enzymes involved in Genome editing are, Zinc Finger Nucleases (ZFNs), Transcription Activator Like Effector Nucleases (TALENs), Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)- CRISPR associated Protein 9 (Cas 9).

The different nucleases are present which are responsible for cut of the DNA .i.e ZFNs and TALENs has FokI and CRISPR has Cas9. The success rate and mutation rate are high in TALENs and CRISPR compared to ZFNs. The procedure for CRISPR is as mentioned below.



(Source: www.allelebiotech.com)

CRISPR is most user friendly genome editing tool and it can be used in therapeutic also while ZFNs have problem of off-target mutations. The CRISPR technology has lot of applications as editing has been done in humans, zebrafish, bacteria, plants, yeast, monkeys, pigs, rats to ensure precision genome engineering (3). These can be used in rectifying birth defects in Human beings and also to obtain designer babies. These have been used in treating AIDS (4) and Haemophilia B in Human beings (5). The genomic medicines will be very useful to treat genetic diseases like sickle cell anaemia, Cystic fibrosis, Huntington's disease. The scientists, lawyers and ethicists, are discussing impact of editing in humans. The editing can also be used in genetic manipulation in crop plants, i.e To design plants which can produce more medicinal compounds i.e Molecular Pharming (Farming), where plants can act as factories to produce desired compound in higher quantities. The rice crop plants have been manipulated through this system to produce low Caesium plants (6), editing stomatal developmental genes in rice (7), Powdery mildew resistant tomato (8), in allotetraploid cotton transgenics (9).

There are certain drawbacks of genome editing which are Off-site mutations, multiple alleles, environmental concerns etc., However, compared to traditional method of genome alterations, the modern methods are user friendly and cheaper. Hence, the genetic manipulations are as per the need, which may contribute more to the increasing diversity of organisms.

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