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A Research on Genetic Engineering in Different Fields

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ABSTRACT

Genetic engineering is the best technology that is promoting the world and this technology is applied to many plants, animals and microorganisms. It has wider applications in the field of Biology, Medicine, Industry, Research, Agriculture and many other fields of science. In this research paper I update the Roles of Genetic Engineering in Agriculture, Animals, Human enhancement and Evolution, Bacteriophage Against Infectious Diseases, Medicines, Phage in Infectious Diseases, Biofuels Production and Improve Plant Performance Under Drought.

Keywords: Food, microorganisms, Human, Transponsale, Animal, Manipulation, Genetic Modification.

Abbreviations: *Genetic Engineering GE; Genetic Modification GM; Carbon dioxide CO_2; Embryonic Stem (ES); C–C Chemokine Receptor Type 5 (CCR5); Polymerase Chain Reaction (PCR); Chronic lymphocytic leukemia (CLL); Wax Ester Synthase/acyl-CoA-Diacylglycerol Acyltransferase (WS/DGAT).*

Introduction

Genetic engineering also called genetic modification or genetic manipulation is through manipulation of an organism's genes using biotechnology. It is a set of technologies used to change the genetic makeup of cells, with the transmission of genes inside and across species limitations to produce improved or novel organisms. New DNA is gained by either isolating and copying the genetic material of interest by recombinant DNA approaches or by artificially manufacturing the DNA. A concept is fragment was made by Paul Berg in 1972 by joining DNA from the monkey virus SV40 with the lambda virus. As well as introducing genes, the procedure can be used to eliminate, or "knock out", genes. The new DNA can be implanted arbitrarily or targeted to an exact part of the genome (Khan et al. 2017).

Direct management of DNA by human's external breeding and alterations have only existed since the 1970s. The term "genetic engineering" was first invented by Jack Williamson in his science fiction novel Dragon's Island, published in 1951 – one year previously DNA's role in inheritance was recognized by Alfred Hershey and Martha Chase,(Stokes et al. 2017). In 1976 Genentech, the first genetic engineering company was invented by Herbert Boyer and Robert Swanson and a year later the company formed a human protein (somatostatin) in E. coli. Genentech broadcast the production of genetically engineered human insulin in 1978. (Miller and Abu-Raddad 2010). Genetic engineering could fix severe genetic disorders in humans by replacing the imperfect gene with a functioning one (MO 2015). It is an important instrument in research that allows the function of specific genes to be studied(Uses and abuses of genetic engineering n.d.; Yadav and Yadav 2016). Drugs, vaccines and other products have been harvested from organisms engineered to produce them (Dna et al. 2016; Nielsen 2013). Crops have been advanced that aid food safety by increasing yield, nutritional value, and acceptance of environmental pressures (Dna et al. 2016; Qaim and Kouser 2013). Plants, animals or microorganisms that have been altered through genetic engineering are called genetically modified organisms or GMOs (Dna et al. 2016). The risk awareness and communication literature appear to use terms such as genetic engineering (GE), genetic modification (GM), and agricultural biotechnology (Agbiotech) almost interchangeably. Some researchers(Frewer, Howard, and Shepherd 1998; Hoban, Woodrum, and Czaja 1992; Zahry and Besley 2017) have chosen for GE, others for GM(Fleming et al. 2007; Miles and Frewer 2003; Zahry and Besley 2017), or Agbiotech and some have used numerous terms(Siegrist et al. 2002; Zahry and Besley 2017).

Attention in a diversity of renewable biofuels has been rejuvenated due to the instability of petroleum fuel costs, the reality of peak oil shortly, a reliance on unstable foreign petroleum resources, and the risks of increasing atmospheric CO2 stages. Photosynthetic algae, both microalgae, and macroalgae(i.e., seaweed), have been of significant attention as a likely biofuel resource for periods. The current study in genetic engineering of animals is concerned with a variety of possible medical, pharmaceutical and agricultural applications. Also, there is an attention to increasing basic information about mammalian genetics and physiology, with complex traits controlled by many genes such as many human and animal diseases(Montaldo 2006). Currently, engineering approaches mainly contain; (i) nuclease-based genome-level editing (i.e., producing transgenic plants), (ii) insertion of exogenous genes, (iii) RNAi at the mRNA level (producing nontransgenic plants), and (iv) protein-level alterations or modifications (Wang, Zhao, and Kopittke 2019).

Role in Agriculture

The first crops to be out commercially on a big scale protected from insect pests or acceptance to herbicides. Fungal and virus-resistant crops have also been settled or are in development (Dna et al. 2016; Goeddel, Kleid, and Bolivar 1979; Marques et al. 2017; Nelson et al. 2018). This makes the insect and weed organization of crops easier and can indirectly raise crop yield. (Demont and Tollens 2004; Dna et al. 2016). The first commercialized GM food was a tomato that had late-ripening, increasing its shelf life (Dna et al. 2016). Four transposable elements, Minos, Hermes, piggyBac, and Mos1 have been used to genetically transform agriculturally important insect species. In all cases, transformation is attained resulting in the so-called P paradigm. Two plasmids, a vector plasmid comprising the transposable part into which a gene of interest and a genetic marker have been cloned, and a helper plasmid holding the relevant transposase gene, are microinjected into blastoderm embryos. Adults stand up from survivors are collected, crossed, and progeny examined for the presence of transgenic individuals. These will contain the integrated transgene but not the helper transposase (which was not located within a transposable element) and so, in the absence of another source of transposase, should be stable. All four of these transposable elements are Class II elements and all typically integrate into the insect genome via a 'cut and paste' machine meaning that only the transposable element sequence (together with the genes and sequences located within the transposable element's inverted terminal repeats (ITRs) transpose into the host's chromosomes. This is true for Hermes element-generated transgenic strains of the stable fly, Stomoxys calcitrans (Atkinson 2002; O'Brochta, Atkinson, and Lehane 2000) and C. capitate (Atkinson 2002; Michel et al. 2001), At current the only example of the construction, using genetic transformation, of an agriculturally vital insect pest destined for limited field trials, and perhaps release, is the assignment of the EGFP gene using the piggyBac transposable element into P. gossypiella by Miller and his colleagues (Atkinson 2002; Peloquin et al. 2000).

Trials designed to measure the fitness of these transgenic insects relative to their untransformed siblings have been future to be led in outdoor cages in Arizona in 2002. The potential for using genetic transformation to crop strains of pest insects that could be used for genetic control of natural pest populations has been self-sufficiently confirmed by Scott and his colleagues (Heinrich and Scott 2000) and by Alphey and his colleagues (Trabalza-Marinucci et al. 2008). Both used the tetracycline-repressible expression system of Escherichia coli to develop genetic strategies in which introducing, by standard crosses, both transgenes into a single fly resulted in the death of females. This happened because the tetracycline-repressible transactivator fusion protein had been placed under the control of promoters know to be expressed only in females (Heinrich and Scott 2000).

Utilized the yolk protein 1 gene promoter-enhancer while (Atkinson 2002). Many bacteria that, while not true endosymbionts such as Wolbachia, exist in the insect gut and are targets for genetic change, leading to phenotypic changes in their insect host (Atkinson 2002; Peloquin et al. 2000); The present study is premised on the idea that using the term 'genetic engineering', 'genetic modification' or 'agricultural biotechnology' represents a framing choice that might affect views about the underlying issue. The effect of this choice of frames, so, deserves attention. Whether achieving a framing effect is intended by the user is unrelated to the current study. What matters is that message study has reliably highlighted the importance of frames in shaping public attitudes and behaviors (Gaj, Gersbach, and Barbas 2013; Zahry and Besley 2017).

QTL analysis and traditional breeding have proven to be valuable for the identification of genes responsible for biotic and abiotic stress tolerance in crops (Herdt 2006; Mittler and Blumwald 2010). Although some overlap is expected, biochemical, physiological, and molecular events trigger specific environmental stress disorder would mostly differ from those activated by a different set of abiotic limitations(Cheong et al. 2014; Denby and Gehring 2005; Fowler and Thomashow 2002; Rizhsky et al. 2004).

Role in Animals

The explanation of transgenic animals has been protracted to include animals that result from the molecular manipulation of endogenous genomic DNA, with all techniques from DNA microinjection to embryonic stem (ES) cell transfer and 'knockout' mouse construction(Montaldo 2006). Compensations in terms of further genetic progress, however, seems to be only marginal from clone evaluation in selection nucleus herds (Box and Ruane 1997). The primary application of genetic engineering to wild species includes cloning. This technology could be applied to either extinct or endangered species; for example, there have been plans to clone the extinct thylacine and the woolly huge (Ormandy, Dale, and Griffin 2011). Genetically engineered farm animals can be formed to improve food quality (Laible 2009; Ormandy, Dale, and Griffin 2011).

Farm species may be genetically engineered to create disease-resistant animals. Genetic engineering has also been functional to reduce agricultural pollution. The best-known example is the Enviropig TM; a pig that is genetically engineered to produce an enzyme that breakdowns down dietary phosphorus (phytase), thus preventive the amount of phosphorus released in its manure (Laible 2009). During the creation of new genetically engineered animals (particularly mammalian species) oocyte and blastocyst donor females may be induced to superovulate via intraperitoneal or subcutaneous injection of hormones; genetically caused embryos may be surgically implanted to female recipients; males may be surgically vasectomized under general anesthesia and then used to induce pseudopregnancy in female embryo recipients; and all offspring need to be genotyped, which is naturally performed by taking tissue samples, sometimes using tail biopsies or ear notching (Ormandy, Dale, and Griffin 2011, 2013).

Other modifications contain a technique referred to as "deathless transgenesis," which includes the introduction of DNA into the sperm cells of live males and removes the need to euthanize females to obtain germline transmission of a genetic alteration; and the use of polymerase chain reaction (PCR) for genotyping, which needs fewer tissue than Southern Blot Analysis (Hokanson et al. 2014). The latter is due, in part, to the limitations in controlling the integration site of foreign DNA, which is inherent in some genetic engineering techniques (such as pronuclear microinjection). In such cases, scientists may produce several self-determining lines of genetically engineered animals that vary only in the incorporation site (Ormandy, Dale, and Griffin 2011)., there are numerous other reports on adult cloned animals involving mice, cattle, cats, goats, pigs, sheep and rabbits relating the same, and other cloning techniques (Montaldo 2006).

Other Ethical Issues Genetic Engineering

Also brings with it anxieties over intellectual property, and patenting of formed animals and/or the methods used to create them. Preservative academic property can breed a culture of privacy within the public, which in turn bounds data and animal sharing. Such limits to data and animal sharing may create states in which there is needless replication of genetically engineered animal lines, thereby stimulating the principle of Reduction. Indeed, this was a concern that was recognized in a recent workshop on the creation and use of genetically engineered animals in science(Ormandy, Dale, and Griffin 2011, 2013).

Composed the Three Rs aim to minimize any pain and distress experienced by the animals used, and as such, they are careful the principles of humane trial technique. However, despite the steps taken to minimalize pain and distress, there is an indication of community concerns that go beyond the Three Rs and animal welfare concerning the creation and use of genetically engineered animals (Macnaghten 2004).

Role in Human enhancement Genetic Engineering and Evolution

There are uncountable specimens where technology has contributed to perfecting the lives of people by improving their characteristics or acquired capabilities. For example, over time, there have been biomedical involvements attempting to reinstate purposes that are deficient, such as vision, hearing or mobility. we consider the human vision, substantial advances started from the time specs were developed (possibly in the 13th century), current in the last few years, with researchers inserting artificial retinas to give blind patients fractional sight (Almeida and Diogo 2019; Pham et al. 2013; Weitz et al. 2015). Lately, researchers have also positively linked the brain of a paralyzed man to a computer chip which helped restore partial movement of limbs previously nonresponsive (Almeida and Diogo 2019; Bouton et al. 2016; Weitz et al. 2015). Also, synthetic blood alternates have been created, which could be used in human patients in the future (Almeida and Diogo

2019; Lowe 2006; Notman 2018). Two eras ago, the performs of human improvement have been described as 'biomedical interventions that are used to improve human form or functioning beyond what is essential to restore or sustain health' (Almeida and Diogo 2019). The range of these applies has now amplified with technological development, and they are 'any kind of genetic, biomedical, or pharmaceutical intervention aimed at improving human characters, capacities, or well-being, even if there is no pathology to be treated' (Almeida and Diogo 2019). it could be useful to group the different kinds of human developments in the phenotypic and genetic categories: (i) strictly phenotypic involvement (e.g. ranging from infrared vision spectacles to exoskeletons and bionic limbs); (ii) somatic, non-heritable genetic interposition (e.g. editing of muscle cells for stronger muscles) and (iii) germline, heritable genetic intervention (e.g. editing of the C–C chemokine receptor type 5 (CCR5) gene in the Chinese baby twins, discussed later on). These categories of enhancement raise different thoughts and apprehensions and currently present different levels of getting by our society. The degree of proper, societal and environmental influences is likely to be more limited for phenotypic interferences (i)but higher for genetic interventions (ii and iii), particularly for the ones which are communicable to future generations (iii) for human beings' (Almeida and Diogo 2019).

Genome editing is measured to achieve much greater accuracy than pre-existing forms of genetic engineering. It has been argued to be a radical tool due to its efficiency, reducing cost and time. This technology is well thought-out to have many applications for human health, in both preventing and tackling the disease. Much of the ethical debate associated with this technology concerns the possible application of genome editing in the human germline, i.e. the genome that can be communicated to the following generations, be it from gametes, a fertilized egg or first embryo divisions (Ishii 2015; MO 2015; Persson and Savulescu n.d.). According to such a view, among many other developments, natural selection has been conditioned by our 'niche-construction' ability to improve healthcare and access to clean water and food, thus altering the landscape of burdens that humans have been facing for survival. A fundamental assumption or position of the current discussion is that, in the interior, our human species, the force of natural selection became minimized and that we are somehow at the'end-point' of our evolution (Almeida and Diogo 2019).

Also, when considering the environmental, ecological and social issues of modern times, some propose that genetic technologies could be crucial tools to contribute to human survival and well-being (Almeida and Diogo 2019; Persson and Savulescu n.d.). The likely need to 'engineer' human traits to ensure our survival could include tenability to allow our species to adapt quickly to the rate of environmental, which Darwinian evolution may be too slow Or, for instance, to support long-distance space travel by engineering resistance to radiation and osteoporosis, along with other conditions which would be highly advantageous in space (Almeida and Diogo 2019).

Genetic Engineering of Bacteriophage Against Infectious Diseases

Bacteriophages (phages), exposed in the early 20th century self-sufficiently by Frederick Twort and Felix d'Herelle, are the most plentiful organisms on earth with up to 2.5 × 108 phages per ml in natural waters (Bergh et al. 1989; Tao 2019). It is well known that phages exactly infect bacteria and, so, we're caring for the development of natural methods to treat bacterial pollutions since their discovery (Salmond and Fineran 2015; Tao 2019; Wittebole, De Roock, and Opal 2014).

Though, due to the discovery of antibiotics that if greater breadth and potency, phage therapy lagged although research sustained in some Eastern European countries (Chanishvili 2012; Tao 2019; Wittebole, De Roock, and Opal 2014). Lately, the rise of multi-antibiotic resistant bacterial pathogens and the low rate of new antibiotic discovery brought new urgency to develop phage-based treatments (Domingo-Calap and Delgado-Martínez 2018; Lu and Koeris 2011; Tao 2019; Viertel, Ritter, and Horz 2014).

Application of Phage in Infectious Diseases

Infectious diseases can be preserved before (prophylaxis) or after (therapy) infection, where phages can donate at both levels to treat bacterial contamination (Debarbieux et al. 2010; Tao 2019). Phages are natural viruses that only infect bacteria, but have similar properties as mammalian viruses, and then can efficiently stimulate an immune response (Jończyk-Matysiak et al. 2017). Therefore, they have the high potentiality to be used as scaffolds to develop approximately applicable vaccine stages (Fehr et al. 1998; Fu and Li 2016; Tao 2019; Tao et al. 2019; Tissot et al. 2010). So far, many efforts have been focused on this topic, and many vaccine platforms have been established using different phages, such as filamentous phages (Henry, Arbabi-Ghahroudi, and Scott 2015), phages λ (Tao 2019), T4 (Bryson et al. 2015)., T7 (Danner and Belasco 2001; Tao 2019)., MS2(Fu and Li 2016), Qβ, and others (Tao 2019; Tissot et al. 2010).

However, phages can include base modification systems to keep their genome resistant to the bacterial R-M systems (Samson et al. 2013; Tao 2019). For example, T4 phage modifies the cytosines by two modifications, 5-hydroxymethylation, and glucosylation, which make it highly resistant to virtually all the restriction endonucleases of E. coli (Bryson et al. 2015). As natural protein nanoparticles, phages can cause immune responses (D browser et al. 2014). Since phage capsids are usually composed of hundreds of capsid protein(s) (Chen et al. 2019), assembly of antigens on a phage capsid will result in highly localized epitope density, which was seen in most of the licensed viral vaccines (Tao 2019).

Role in Medicines

Genetic engineering has many applications to medicine that include the industrial of drugs, the formation of model animals that mimic human conditions and gene therapy. One of the initial uses of genetic engineering was to manufacture human insulin in bacteria(Goeddel, Kleid, and Bolivar 1979). This application has now been practical too, human growth hormones, follicle-stimulating hormones (for treating infertility), human albumin, monoclonal antibodies, antihemophilic factors, vaccines, and many other drugs (Aslam et al. 2018). Gene therapy is the genetic engineering of humans, usually by replacing defective genes with effective ones. Scientific research using somatic gene therapy has been conducted with several diseases, including X-linked SCID,(Fischer, Hacein-Bey-Abina, and Cavazzana-Calvo 2010; Swaminathan 1969).

Chronic lymphocytic leukemia (CLL),(Brentjens et al. 2013; Dna et al. 2016) and Parkinson's disease(LeWitt et al. 2011). and Parkinson's disease(LeWitt et al. 2011). In 2012, Alipogene tiparvovec became the first gene therapy treatment to be accepted for clinical use. In 2015 a virus was used to insert a healthy gene into the skin cells of a boy suffering from a rare skin disease, epidermolysis bullosa, to grow, and then graft healthy skin onto 80 percent of the boy's body which was affected by the illness (Dna et al. 2016).

Role in Biofuels Production

Engineering procedures for the production of biofuels using energy-rich carbon storage products, such as sugars and lipids, are well established and are currently being used on a large scale in the production of bioethanol from corn grain and biodiesel from oilseed crops. However, it might be possible to introduce biological pathways in microalgal cells that allow for the direct production of fuel products that require very little processing before distribution and use. An interesting exampleis the in vivo conversion of fatty acids to fuel by the simultaneous overexpression of the ethanol production genes from Zymomonas mobilis and the wax ester synthase/acyl-CoA-diacylglycerol acyltransferase (WS/DGAT) gene from the Acinetobacter baylyi strain ADP1 in E. coli, which resulted in the synthesis of fatty acid ethyl esters that could be used directly as biodiesel. Strains of B. braunii differ in which long-chain hydrocarbons are synthesized, with strain A producing very-long-chain dienes and trienes, while strain B produces very-long-chain triterpenoid hydrocarbons (Radakovits, Jinkerson, Darzins, and Posewitz 2010). Decarbonylase activity has also been found in the leaves of the pea Pisumsativum (Radakovits, Jinkerson, Darzins, Posewitz, et al. 2010;

Schneider-Belhaddad and Kolattukudy 2000; Vioque and Kolattukudy 1997), and several possible decarboxylases that are thought to be involved in the wax formation, including Cer1 and Cer22, have been found in A. thaliana (Aarts et al. 1995; Radakovits, Jinkerson, Darzins, Posewitz, et al. 2010; Rashotte et al. 2004). Other compounds that could replace diesel and jet fuel can also be produced throughisoprenoidpathways (Fortman et al. 2008; Lee et al. 2008; Radakovits, Jinkerson, Darzins, Posewitz, et al. 2010). Maize (Zea mays) and sugarcane (Saccharum officinarum) remain the world's largest biofuel-producing feedstocks (Bhatia et al. 2017).

These economic important grasses are currently used for respective starch and sucrose-based bioethanol creation via fermentation and accounted for ~85 billion liters of bioethanol and ~85% of international bioethanol output in 2016. Efforts to make the deconstruction of lignocellulosic biomass economically viable and environmentally friendly have focused in three main areas: **(i)** improved pre-processing (e.g. mechanical, thermochemical)); **(ii)** improved processing through more efficient enzymes and microbes capable of tolerating toxic inhibitors, withstanding high product and by-product attentions during biomass digestion and the subsequent fermentation process, and **(iii)** developing less recalcitrant feedstocks (Agbor et al. 2011; Alvira, Ballesteros, and Negro 2010; Balat 2011). Currently, the popular of biofuel production in the United States is in ethanol derived from starch- or grain-based feedstocks, such as corn (maize). Sugarcane is also a prime resource for biofuel production in Brazil [6] and other regions of the world. Reaching a production level of 24.6 billion liters (6.49 billion gallons) in 2007 (Bhatia et al. 2017).

Genetic Engineering to Improve Plant Performance under Drought

It is a measurable trait. (Peleg et al. 2011) known that 'plants exhibited delayed response to stress' but 'delayed stress onset' is a different concept—depletion of water reserve induces water deficit and stress in the plant, rather than 'stress' being applied when it is water supply which is stopped foremost to a deficit in the soil. Of great importance was the exploration of induction of gene expression caused by drought in plants, chiefly in the 'model' species Arabidopsis thaliana (Greco et al. 2013). Which has partially the way of drought-related studies since. This has resulted in the identification of 'candidate genes' (Greco et al. 2013; Le et al. 2011), likely to confer DR in crop species. Wide-ranging effects and aids have been likely from altering or introducing many types of genes and altering their regulation, for example, gene promoters and transcription factors (Greco et al. 2013).

More recent selection breeding, applying scientific principles (Greco et al. 2013; Tuberosa et al. 2007), has also not given crops which are unaffected by drought, but has led to smaller developments; for example, application of carbon isotope taste in wheat breeding (Rebetzke et al. 2008; Richards et al. 2010) has improved yields by ~5% with drought which reduced yield by 50%, and by 10% with a 75% decrease in yield. Breeding for DR is careful. Focus on the minutiae of mechanisms is required for thoughtful, but consideration of the whole system is also important (Greco et al. 2013).

Why Genetic Engineering is Important?

Genetic engineering is the field of biotechnology that deals with genes. It is a very good field for human beings to get inventions inside the human body too. Assume, we take genes from bacteria and these genes in bacteria produce proteins for any beneficial characters and then these are introduced inside the human body, there these genes will express and show the best characters and directly mankind will get benefits. So, different genes are injected into human beings to improve human organs and bodies.

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