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Introduction

The issue of using animals in scientific research is one many people are strongly against, due to ethical concerns and animal rights, but also one where people believe it is compulsory for the health and advancement of humans and that it outweighs the negatives, and so are for it. Testing on animals for cosmetics is banned in New Zealand, however, the use of animals in testing, research, and teaching (RTT) is still prominent today. 300,000 animals, from rats to dogs to cows, are used for experimentation each year in NZ, with 176 killed each day, on average. Therefore, the issue of animals being used in research still remains today in NZ, so I will be discussing the biology of it, implications, and opinions, which leads to my own opinion and position regarding the topic.

Biological concepts and processes

One way animals are tested upon for scientific research is by making them disease models, meaning that they are given a disease found in humans to discover possible treatments for humans. This is done through the process of transgenesis, where in this case, the gene of the human disease is inserted into the genome of an animal, which is made through the process of somatic cell nuclear transfer (SCNT).

Transgenesis begins with designing a gene construct. A gene construct is a DNA segment which has an antibiotic resistant gene (to be able to select the cells with the transgene later on), a promoter sequence (to initiate the start of the gene expression), the gene of interest (disease gene), and a stop sequence (to end the process of gene expression). The desired gene (transgene) which codes for the specific characteristic (in this case - the specific disease), first needs to be identified in the DNA sequence. Next, that gene is to be isolated (separated) from the other parts of the DNA, which is done by cutting it with a restriction enzyme. For the transfer, vectors (which are molecules of DNA used to carry foreign DNA into the target cell) can be used. A plasmid (found in bacteria) is a common type, and the transgene joins with this with the help of the enzyme DNA ligase, provided they have complementary nucleotides, resulting in recombinant DNA. This recombinant DNA (which is a gene construct) is transferred into the genome of an animal's (such as a mouse) cell through transfection, during which chemicals or electrical pulses are used on the cell to create holes in the cell membrane, allowing the gene construct to enter the cell and reach the animal's genome in the nucleus. An antibiotic is added, causing the cells which have the transgene successfully incorporated into the genome of them to survive (as they are resistant, having the antibiotic resistant gene), and the others to die. A cell that is confirmed to be transgenic is then used to create an entire transgenic organism, such as a mouse, through the process of somatic nuclear transfer.

Somatic cells (cells other than the sex cells/gametes) of an organism are diploid, meaning they have two sets of chromosomes (one maternal and one paternal). During SCNT, the diploid nucleus is extracted out of a somatic cell of the organism that is to be cloned (such as of a mouse), which in this case would be the nucleus of the transgenic cell created earlier. A haploid nucleus (containing one set of chromosomes) from another organism (e.g. another mouse) is also taken out, from an egg, enucleating both the somatic and reproductive cell. The diploid nucleus is then inserted into the cytoplasm of the enucleated egg, which simulates a zygote (a fertilised egg). The zygote is then given an electric shock, which stimulates the process of cell division, ultimately forming an embryo. The embryo is then implanted into a surrogate, back in a uterine environment, where it grows into a fetus, and continues to grow until it has fully developed into a transgenic animal which expresses the disease that was present in the somatic cell (since it was the DNA of that cell which was used). Because only DNA that is present in sex cells can be passed on during meiosis/mitosis, SCNT ensures that the DNA containing the transgene would be present in every single cell of the animal, resulting in a transgenic animal expressing the phenotype of the diesease (e.g. transgenic mouse expressing Huntington's disease).

Biological implication

A biological implication of using animals in scientific research is the probability of providing inaccurate results which could be harmful to human health, and in the long run prevent safe treatments from being developed as soon as possible. Some substances can be effective in treating animals, but impose serious risks to humans, and vice versa. In Sepsis research, 150 cures that were made and were effective in mice, did not work on humans, and even caused some results where the sepsis infection had worsened. Animals do not naturally get several diseases that humans can, such as HIV, Parkinson's, Alzheimer's, or schizophrenia, and so the results of animal tests can be severely affected due to the differences and complexities of the human body, compared to that of a laboratory animal. It can even deter scientific research from the correct path of finding treatments and slow down the rate. Aspirin, which ended up being "One of our most relied-upon pain relievers" had caused "teratogenic malformations in mice, rats, dogs, cats, rabbits, and monkeys." Vioxx is an example of a drug that was tested as safe (for treating arthritis) among six non-human animal species, in at least eight studies. However, it caused approximately 140,000 deaths and 320,000 strokes and heart attacks around the world. Animal disease models are used in attempts to find a treatment for Alzheimer's disease, but 99.6% of drugs that work successfully in animal tests for it are unsuccessful in trials with humans. Therefore, due to the high percentage of failure in the development of a working drug using animal tests, alternatives to animal models should be used to provide safer options and reduce risks for individuals in NZ and around the world.

Social implication (ethical)

A social implication of using animals in scientific research is the several ethical issues it brings about. Causing unnecessary suffering to animals is considered cruel and morally unjustified, because of the several alternatives available, such as cell cultures (in vitro testing, organs-on-chips), human tissues, computer models (such as for teaching), and human volunteer studies. Animals are living organisms, and are sentient, meaning that they are capable of experiencing feelings, such as pain, and therefore many believe that its right to live without suffering is something humans do not have a right to violate. In NZ, around 300,000 animals are used for RTT per year, and in 2016, 62,401 were killed. An example of an unethical practice occurring in NZ is the 'Forced Swim Test.' This test has the aim of imitating the complex behaviours of human depression and stress, however, has repeatedly failed in doing so. There is no evidence showing any relevance to it, deeming this test unnecessary and unethical. Neuroscientist Eric Nestler says that "We don't know what depression looks like in a mouse." Forcefully inserting genes that code for human diseases into animals (that they otherwise would not get), is also unethical, as it is an unessential procedure (of SCNT and transgenesis) and results in inaccurate and unhelpful disease models. In New Zealand, the majority of animals used in research are used for ones that are agricultural, in an attempt to make the animal more beneficial for the industry by undergoing experiments such as to produce unnatural amounts of milk. These experiments all pose ethical concerns, as they threaten the health of these animals and violate their basic living rights.

Different opinions/viewpoints

The argument for animal testing involves the view that animals are biologically very similar to humans, and so animal models can be very effective for human treatments. Professor Sir George Radda believes that "...animal research is essential to tackling major 21st century health problems such as cancer and heart disease. Without the use of animals it would be impossible, in many cases, to develop drugs or any sort of medical treatment."

The argument against animal testing involves the idea that it is ethically wrong to put the lives of animals, being sentient beings, at risk, and considers the many other alternatives that exist to be more reliable. Dr. Elias Zerhouni, former director of the National Institutes of Health believes "The problem is that [testing on

animals] hasn't worked, and it's time we stopped dancing around the problem...We need to refocus and adapt new methodologies for use in humans to understand disease biology in humans."

Personal position

My personal position on the issue of using animals in scientific research is that it should not be done for cosmetic (already banned in NZ) or medical purposes if it causes pain or suffering to the animal, and that the many alternatives that exist today should be used instead, as it provides more reliable results that is beneficial for human health. I have formed my opinion based on the research that I have gathered and the different viewpoints that I have explored. Joan Ryan's comment of animal research being "part in almost every medical breakthrough of the last century" and "sav[ing] hundreds of millions of lives worldwide" is quite generalised, and contradicts the fact that 95% of all drugs that showed results of being effective and safe failed in trials with humans, according to the National Institutes of Health (NIH). Moreover, based on her biography, she has no scientific background which may have helped her in making an informed opinion. She comments on how several lives have been saved, focusing on only one side of the issue and ignoring the several deaths of both humans and non-human animals that animal experimentation has caused, such as with Vioxx. This gives the impression that her view is biased, and with her being a politician, could likely be because she would like to promote herself as being in favour of the UK's advancement in animal research and gaining the support of those facilities and those associated with it. I disagree with Professor Sir George Radda's comment of "...animal research is essential to tackling major 21st century health problems such as cancer," as I learn from Dr. Richard Klausner, former director of the US National Cancer Institute, that researchers "have cured mice of cancer for decades and it simply didn't work in human beings." I am in the position that I am with this issue because the information that I support is from various sources, (cross-checked to prevent incorrect information). The majority of them are '.org' websites, such as www.nzavs.org.nz, www.crueltyfreeinternational.org, and safe.org.nz, which usually means that they are a non-profit organisation (which those examples are), and therefore are likely to present information in a way that is not misleading, for one's own personal gains like maximising profit. Several quotes and information I have gathered are from the NIH, which is a heavily trusted research centre that was ranked 2nd in the world for biomedical sciences by the Nature Index last year. The opinion that I have, because of the research, is further reinforced by the negative implications that animal testing has. The biological consequence of it providing insufficient information for human treatments (such as with the Alzheimer's disease study), along with possibilities of conditions worsening (such as with the Sepsis study) is far too high, and along with the ethical consequence of making animals suffer, and having over 60,000 killed annually in NZ, an activity as such is just not worth it. In the long term, the biological implication can prevent safe treatments from being developed as soon as possible. Therefore, I am against the use of animals in scientific research if it causes unnecessary harm, and support the use of cruelty free alternatives.

Resources

https://www.nzavs.org.nz/articles/2016-animal-use-statistics-summary/
https://safe.org.nz/our-work/animals-in-need/animal-testing-in-nz/science-experiments/
https://www.peta.org/features/expert-quotes-reasons-animal-testing-unreliable/
https://www.crueltyfreeinternational.org/why-we-do-it/alternatives-animal-testing
http://www.animalresearch.info/en/resources/quotes/
https://www.nzavs.org.nz/articles/animals-dont-get-huntingtons-disease/
https://www.nzavs.org.nz/articles/ad-research-without-animals/
https://www.crueltyfreeinternational.org/why-we-do-it/arguments-against-animal-testing
https://www.pathwayz.org/Tree/Plain/TRANSGENESIS
https://www.sciencelearn.org.nz/resources/2035-restriction-enzymes
https://www.sciencelearn.org.nz/resources/857-techniques-used-to-make-transgenic-cows
https://www.sciencelearn.org.nz/resources/2034-dna-ligation

https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/a/overview-dna-cloning
https://www.sciencelearn.org.nz/videos/451-making-transgenic-bovine-cells
https://www.huffpost.com/entry/animal-testing-diseases_b_3813856
https://www.crueltyfreeinternational.org/why-we-do-it/arguments-against-animal-testing
https://www.onegreenplanet.org/animalsandnature/5-ways-animal-testing-hurts-humans/
https://www.labome.com/method/Huntington-s-Disease-Animal-Models.html
https://theconversation.com/of-mice-and-men-why-animal-trial-results-dont-always-translate-to-humans-7335
https://www.nzavs.org.nz/laws-and-regulations4
https://www.pennmedicine.org/news/news-releases/2012/may/nsaids-and-cardiovascular-risk
https://www.nzavs.org.nz/forced-swim-test/
https://www.nih.gov/
https://www.youtube.com/watch?v=vPvToD6kgmE&t=213s
https://www.youtube.com/watch?v=RzYhcXjksKc
ESA Level 3 Biology Study Guide, Anna Roberts & Maria Sinclair
ESA Level 3 Biology Learning Workbook, Anna Roberts & Maria Sinclair