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DNA Profiling: How Long is the Golden Snitch's Flesh Memory?

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Abstract
Will the Flesh Memory of the Golden Snitch really last seven years? The Golden Snitch is a ball used in the game of Quidditch that remembers the first person to have contact with its surface. Analysis of forensic techniques, in particular DNA profiling and the effects of temperature are used to model whether the Snitch would recognise Harry Potter seven years later. If stored at room temperature (21^{o}C), this would not be possible. The model is then extended to calculate the average temperature of storage required for this to be possible, 10.08^{o}C.

Introduction
In J.K. Rowling's fictional world of Harry Potter, the golden snitch is the smallest of the three balls used in the game of Quidditch. The game is won once the seeker from either team catches the snitch.

The golden snitch exhibits a unique property known as "Flesh memory". This allows it to remember the individual that first touches it and can therefore be used to determine the outcome of a match. It is for this reason that gloves are worn by all handling the snitch prior to the start of a match [1].

The property of Flesh Memory of the snitch was used in the novels to conceal an item passed to Harry upon the death of Albus Dumbledore, which occurred seven years after the initial contact between Harry and the golden snitch used in his first Quidditch match [2].

How the Snitch Works?
For the golden snitch to be able to identify individuals based on the first touch to its surface, it has to recognise a unique feature of the individual. Fingerprints would be the most likely solution to this problem as the fingerprint ridge patterns are unique to an individual [3]. However it is shown in "Harry Potter and the Philosopher's Stone" that it is also possible to catch the snitch without using hands, as Harry Potter catches the ball with his mouth [4]. Therefore it is more likely that the snitch uses DNA to identify the individual. It is assumed that in order for the snitch to identify the individual, the DNA it is in contact with must match that present on its surface.

DNA Degradation
Although a useful form of identification, with a wide range of applications - including within Forensic Science - organic matter DNA undergoes degradation processes over time. Such degradation reducing its effectiveness as evidence and as an identification tool.

Degradation of DNA occurs through both enzymatic and chemical processes. These processes include the digestion of DNA, and disruption of the bonds between the component monomer units of DNA, the nucleotides [5].

Another important factor in DNA degradation is the environmental conditions in which the DNA sample is present, with conditions such as increased temperature accelerating the decomposition process.

Soft Tissue DNA Samples
The tissue in which a DNA sample resides plays a large role in the protection from degradation with hard tissues such as bone and teeth offering more protection from degradation processes than soft tissues. This results in the half-life of DNA in hard tissues being approximately 521 years [6].

In the case of samples obtained from soft tissue samples, the rate of DNA degradation is much more

difficult to determine, as little to no protection is offered by the tissues. Whilst there is no definitive half-life for DNA from soft tissues, a study performed by Ellingham et al. [7] in 2012, identified a method that can be used to determine the effectiveness of DNA samples obtained from soft tissues upon removal from the host.

This method utilises a quantity known as Accumulated Degree Days (ADDs). ADDs are used as degradation of these samples was found to be more dependent on the temperature conditions rather than just time. Degree Days are calculated through taking the average temperature in which the sample was stored per day and comparing to a baseline temperature, which for most organisms is 10°C [8]. ADDs are then calculated by taking the sum of the Degree Days as shown below:

$$ADD = \sum \frac{T_{max} + T_{min}}{2} - T_{base}$$

The results from the study by Ellingham et al. state that full DNA profiles from soft tissue samples can only be obtained at 200 ADDs at the latest. The reasoning for this is the degradation of the sample, along with the addition of microbial DNA that would inevitably become present due to the degradation process [7], make obtaining a profile unlikely.

Flesh Memory Model

In order to model how long the Flesh Memory of the Golden Snitch would last, the ADD calculation was used. It is assumed that after capture of the golden snitch, it would be stored in a room that is at room temperature. This is defined to have a minimum of 18°C and a maximum of 24°C [9]. It is also assumed the DNA sample collected by the snitch is also that of a soft tissue sample, as there is no contact with DNA from hard tissue. These values were put into the equation stated above to provide the number of days the sample would be useful for, assuming the temperature of the room was within these limits every day.

$$200 = n\left(\frac{24 + 18}{2} - 10\right)$$

where *n* represents the number of days. Rearranging this gives the maximum number of days for which a full DNA profile could be obtained.

$$n = \frac{200}{21 - 10}$$

$$n = 18\ days\ (2SF)$$

This shows that the snitch would be able to identify its target individual for a maximum of 18 days after contact.

As the model shows the snitch would not be able to recognise an individual after seven years if stored at an average temperature 21°C, it can then be extended to calculate the average temperature that would be required. This is done by rearranging the equation for ADDs and applying it to *n*=2556, where 2556 is the number of days in 7 years.

$$2556 = \frac{200}{T - 10}$$

$$T = 10.08\ ^{o}C$$

This shows that the snitch would need to be stored at an average temperature below 10.08°C in order to be able to recognise an individual seven years later.

Conclusion

The results from our model suggest that at this stage the snitch should not have been able to identify Harry from the DNA present on the surface as the 18 days in which a full profile could be obtained falls far short of the remaining 2538 days that would have passed. After this time elapsing it is certain that even a partial profile would be difficult to obtain from the snitch [7].

Extending the model then shows that in order for the DNA profile to be preserved on the snitch for 7 years, it must be stored at a temperature below 10.08°C. Therefore the office of Albus Dumbledore would not have been suitable.

References

[1] Rowling, J.K. (2007), *Harry Potter and the Deathly Hallows*, Bloomsbury, Chp. 7
[2] Rowling, J.K (2007), *Harry Potter and the Deathly Hallows*, Bloomsbury, Chp. 34
[3] Jackson, A. & Jackson, J. (2011), *Forensic Science*, Pearson Education, 3rd ed., pp.108-123

[4] Rowling, J.K. (1997), *Harry Potter and the Philosopher's Stone*, Bloomsbury, Chp. 11
[5] Butler, J.M. (2011), *Advanced Topics in Forensic DNA Typing: Methodology*, Elsevier, 1st ed., Vol. II, pp.293-311
[6] Kaplan, M., (2012 – last update), *Nature News - DNA has a 521-year half-life*, [Online]. [Accessed 04th February 2015]. Available from: http://www.nature.com/news/dna-has-a-521-year-half-life-1.11555
[7] Ellington, S & Goodwin, W., (2012 – last update), [Online]. Available from: http://www.aafs.org/sites/default/files/pdf/ProceedingsAtlanta2012.pdf [Accessed 04/02/2015].
[8] Womach, J., (2005-last update), *Agriculture: A Glossary of Terms, Programs, and Laws, 2005 Edition*, [Online]. Available from: http://www.cnie.org/NLE/CRSreports/05jun/97-905.pdf [Accessed 04/02/2015].
[9] Hartley, A., (2006 – last update), *Fuel Poverty*, [Online]. Available from: http://www.wmpho.org.uk/resources/Fuel_Poverty_Short.pdf [Accessed 04/02/2015].