

Using DNA to Pick a Winner

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SCIENTIFIC



TECHNOLOGICAL



ECONOMIC

SUMMARY

The Thoroughbred horse racing and breeding industry is an international, multi-billion euro business, with more than 100,000 foals born each year. What makes one horse run faster than another is the question that has perplexed race goers for generations.

Dr Hill's research into the so-called 'speed gene' began in 2004 when she received funding from Science Foundation Ireland to investigate the genetic influences on racing performance in Thoroughbred horses. Built around scientific excellence her research led to the development of a 'Speed Gene' Test which can predict the best race distance (short, middle or long) for an individual horse. She set up a spin-out company, Equinome in 2010 to commercialise her scientific results.

The key impacts are economic in terms of jobs created by the new company as well as scientific in that this proprietary technology has the potential to transform how those in the multi-billion global bloodstock industry make key decisions.

This ground breaking research places Ireland at the forefront of the Thoroughbred horse breeding industry by applying science to horse performance.

DESCRIPTION

In 2004 Dr Emmeline Hill was awarded a President of Ireland Young Researcher award from Science Foundation Ireland, to establish at UCD the world's first academic research programme dedicated to understanding genetic contributions underlying athletic traits in the Thoroughbred. While the research was initiated before the horse genome was sequenced in 2007, this advance enabled the research team to utilise the new genomic tools for the horse, that had previously been unavailable.

Relying on access to DNA samples from co-operation with trainers and breeders in Ireland and internationally, the team started to build up a valuable set of reference samples. As well as evaluating differences in the DNA sequence the researchers investigated differences in gene expression in the skeletal muscle of the horse and began an understanding of the metabolic changes that occur in response to exercise and training. This research led to the publication of the world's first description of a gene contributing to a specific performance related trait in Thoroughbreds. They found that a variant in the myostatin gene had an unexpectedly large and singular effect on the distance to which a racehorse was best suited, and they called this 'The Speed Gene'.



Dr Emmeline Hill and Mr Jim Bolger, the renowned Irish racehorse trainer and breeder, pictured with Banimpire, a multiple-Group race winning racehorse.



DETAILS OF THE IMPACT

Following the discovery of 'The Speed Gene' the spin-out company Equinome was co-founded by Dr Hill and Jim Bolger, one of Ireland's leading racehorse trainers who has an international reputation for producing world class horses. Equinome was established to commercialise the original research finding and to further develop genetic tests relevant in the international Thoroughbred breeding and racing industries.

"I have seen examples within my own horses that demonstrate how the Equinome genetic test results can be a more accurate indicator of the optimum distance for an individual than pedigree alone."

JOHN HAMMOND TRAINER, FRANCE

"We have begun and intend to continue to utilise this highly valuable tool to fine tune decision making in our operation. This will fundamentally change the way we will have to think about breeding in the future."

JOHN O'CONNOR, MANAGING DIRECTOR BALLYLINCH STUD, IRELAND

"The global movement of horses and the vagaries of regional racing programmes mean that sometimes a pedigree doesn't always give the truest picture of a horse's natural aptitude regarding its best distance and precocity. I have found the Equinome Speed Gene Test an extremely useful tool in levelling those differences and giving some concrete data that can help provide a more tailor-made training programme for each horse. This helps give the horse and owner their best possible chance for success."

FRANCIS-HENRI GRAFFARD, TRAINER, FRANCE

"We are most impressed by the theory which appears to be supported by stringent laboratory research. We now look forward to benefiting from the application of Equinome's services"

TERRY HENDERSON, OWNER, OTI RACING, AUSTRALIA

Racehorse owners and trainers now use the genetic information to inform purchasing and training decisions and to identify the most appropriate races for their horses. Breeders, stallion managers and bloodstock agents use the test to make more precise selection and breeding decisions.

In 2011, Equinome produced a second product the Equinome Elite Performance Test. This identifies horses with the greatest genetic potential for racecourse success.

In December 2015 Equinome was acquired by Plusvital, the Irish equine nutrition company. The newly expanded Plusvital will substantially invest in the development of novel equine genomic tests, innovative nutraceuticals and other equine performance and health products.

In 2016 the company has customers in more than 18 countries in all the major bloodstock regions in the world and employed 15 people in Ireland as well as having a permanent office in Australia.

The existing world-class research team, led by co-founder, Dr Emmeline Hill (Chief Science Officer, Plusvital), will be strengthened with the recruitment of additional highly-qualified researchers and sales and marketing staff. The combined business will employ over 35 highly qualified scientists and professionals by the end of 2017.

Mike Shelly, CEO of Plusvital said "The acquisition of Equinome will enable the business to leverage its global sales and marketing network. The business will expand through the research, development and launch of unique product offerings in addition to our current range of supplements and genetic tests."

"We are delighted that Equinome is becoming part of Plusvital at this exciting stage in the growth of both companies. We have a suite of novel products and services that we will bring to market in 2016 and we will continue to invest heavily in our research and development pipeline." added Shelly.

Dr Emmeline Hill, Plusvital's new Chief Science Officer said "The merger of Plusvital and Equinome represents a transformative step forward in the development of a world-leading equine sciences company that will deliver groundbreaking new services in equine performance and health management, including the exciting emerging field of nutrigenomics."

RESEARCH REFERENCES

- Bower MA, McGivney BA, Campana MG, Gu J, Andersson LS, Barrett E, Davis CR, Mikko S, Stock F, Voronkova V, Bradley DG, Fahey AG, Lindgren G, MacHugh DE, Sulimova G, Hill EW. The genetic origin and history of speed in the Thoroughbred racehorse. *Nature Communications*, 2012, 3:643 DOI: 10.1038/ncomms164
- Hill, E.W., et al., Method for predicting athletic performance potential of a subject, in United States Patent Application Publication. 2011: US2011/0262915 A1 USA. [Patent Application]
- Hill EW, Fonseca RG, McGivney BA, Gu J, MacHugh DE, Katz LM. MSTN genotype (g.66493737C/T) association with speed indices in Thoroughbred racehorses. *J Appl Physiol* (1985). 2012 Jan;112(1):86-90. DOI: 10.1152/jappphysiol.00793.2011. Epub 2011 Oct 20.
- Hill, E.W., et al. A method for predicting athletic performance potential. World Intellectual Property Organization. 2010: WO 2010/029527 A1 International Application Published under the Patent Cooperation Treaty (PCT). [Patent application]
- Hill EW, McGivney BA, Gu J, Whiston R, MacHugh DE. A genome-wide SNP-association study confirms a sequence variant (g.66493737C>T) in the equine myostatin (MSTN) gene as the most powerful predictor of optimum racing distance for Thoroughbred racehorses. *BMC Genomics*. 2010 Oct 11;11:552. DOI: 10.1186/1471-2164-11-552.
- Hill EW, Gu J, Eivers SS, Fonseca RG, McGivney BA, Govindarajan P, Orr N, Katz LM, MacHugh DE. A sequence polymorphism in MSTN predicts sprinting ability and racing stamina in thoroughbred horses. *PLoS One*. 2010 Jan 20;5(1):e8645. DOI: 10.1371/journal.pone.0008645. Erratum in: *PLoS One*. 2010;5(1). DOI: 10.1371/annotation/de9e11b9-eb92-4ee5-a56a-908e06d1ed6c.

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Donal Ryan, Managing Director Equinome; Mike Shelly, CEO, Plusvital and Dr Emmeline Hill, co-founder, Equinome

