"IT AIN'T ROCKET SCIENCE"

The history of embryo transfer in alpacas.

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IN 2015, the Australian Alpaca Association celebrated 25 years since its inception, providing a perfect opportunity to look back over the years to see how different facets of the alpaca industry have evolved.

Alpacas are bred for their soft, fine, lightweight fibre, which is processed into fashion garments and other luxury products. Alas, their gestation period averages 342 days, twins are rare, and males may take two to three years to sexually mature, ensuring slow genetic progress using natural breeding methods. Embryo transfer has provided the means to more rapidly multiply alpacas judged to possess high genetic merit (**Figure 1**), as artificial insemination is still not a commercially viable option.

Embryo transfer has been being performed in camelids for more than five decades. Initial attempts in South America in the 1960's (Novoa & Sumar 1968) and 1970's (Sumar et al. 1974) used surgical techniques combined with general anaesthesia to access the reproductive tract of alpacas and llamas. The 1980's saw the development of non-surgical techniques (Wilson Wiepz et al. 1985, Sumar and Garcia 1986) whereby a catheter was passed through the cervix of a sedated animal and embryos harvested from a conscious but sedated patient.

With the advent of veterinary ultrasound technology, where a transducer could be placed into the rectum of an animal to "look" at the reproductive tract non-invasively and on a daily basis, a better understanding of ovarian function was gleaned in both Old World and New World camelids (**Figure 2**; Adams et al. 1989, 1990, 1991, Bravo et al. 1990, 1991, Bourke et al. 1992a, Tinson and McKinnon 1992).

Figure 1. Dr Julio Sumar in the show ring, judging alpacas in Arequipa, Peru 2014 (Photo kindly supplied by Robin Näsemann).

Figure 2. Dr Marcelo Ratto ultrasounding ovaries of a llama, University of Saskatchewan, Canada in 2003

Embryo transfer in camelids has allowed commercial breeders to more rapidly increase selected genetics in their herds

Repeated, trans-rectal ultrasonography of ovaries in different species of domestic livestock has shown that ripening eggs develop in waves (Adams 1999). A small group of follicles (the fluid-filled structure on the ovary that each contain an oocyte or egg) develops on both ovaries, and one follicle is selected and keeps growing, while the rest of the follicles in that cohort regress and the eggs within them die. Sometimes two follicles develop simultaneously and become dominant, resulting in the release of two eggs if mated, leading to sporadic twinning. It has been determined that the optimal time for applying any hormonal treatment to stimulate the growth of multiple eggs rather than one or two, is at the time of new wave emergence. This is the basis of developing multiple ovulation (commonly known as "superovulation") techniques in all species.

MULTIPLE OVULATION

Multiple ovulation, combined with natural mating and non-surgical collection and transfer of embryos has been performed successfully since the early 1990's in llamas (Bourke et al. 1992b, 1992c, 1995) and camels (**Figure 3**; Skidmore 1992, McKinnon and Tinson 1994, Musa et al 1993) and more latterly, alpacas (Ratto et al 1999, Hopkins 2002).

Embryo transfer in camelids has allowed commercial breeders to more rapidly increase selected genetics in their herds, be it fleece in alpacas and llamas, or milk production or athletic ability in camels. The commercialisation of the technology in South American camelids has occurred in various countries such as the United States (Taylor et al 2000), Australia (Clancy 2002), Europe (Hebditch 2004) and Peru (**Figure 4**; Watters 2007).

Embryo freezing has been performed on a very limited basis (Aller et al 2002, Skidmore et al 2005, Sansinena 2007) and has yet to be commercialised. The main barrier to success is the large size of embryos at the time of flushing, and that they have "hatched" from the protective zona pellucida or gel coat, which protects embryos of other domestic livestock such as sheep and cattle during freezing, thawing and transfer of embryos (**Figure 5**).

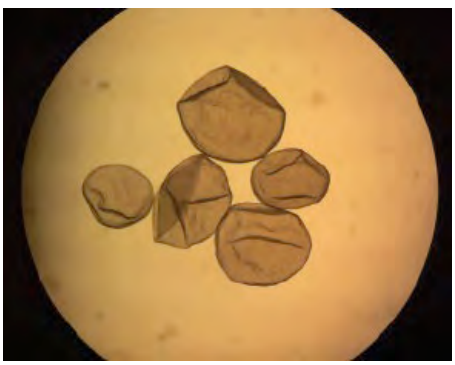
WHAT YOU NEED TO KNOW

Whilst embryo transfer is not rocket science, it is based on biological science and a sound knowledge of camelid anatomy and physiology. The ability to harvest embryos from donors and transfer embryos into recipients goes hand-in-hand with the welfare and on-going fertility of the animals undergoing embryo transfer (**Figure 6**). Success is linked to a sound understanding of camelid reproductive function, and how best to

Figure 3. Dr Lulu Skidmore flushing a dromedary camel, Camel Reproductive Centre, Dubai in 2001.

Figure 4. Dr Rito Huayta searching uterine flushing fluid for embryos, Pacomarca, Peru in 2007.

Figure 5. Alpaca embryos 1-2 mm in diameter, under the microscope prior to transfer. Embryos hatch out of their zona pellucida during descent down the oviduct and enter the uterus as hatched blastocysts, thus rendering them more difficult to freeze compared with un-hatched embryos of sheep and cattle.



implement optimal husbandry with appropriate pain relief to ensure animals are comfortable during the implementation of any programme.

There is no doubt that embryo transfer has allowed breeders utilising the technology to more rapidly advance the quality of their alpacas, thus allowing the production of more and finer fleece (**Figure 7**). On-going research by scientists to improve embryo transfer techniques continues across the globe. The Camelid Satellite Symposium of the International Congress on Animal Reproduction, previously held in Budapest in 2008 and Vancouver in 2012, allows researchers to share recent findings and latest technologies. New information is also published in international reproduction journals, which allows scientists throughout South and North America, the Middle East, Asia, Europe and Australia to share their findings on camelid reproduction and artificial breeding.

Jane is an Australian veterinarian who obtained a PhD studying control of ovarian function in alpacas. She has been performing embryo transfer in Australia, New Zealand and Britain since 2001.

Figure 6. Former dentist, Paul Taylor watches wife Sally flush a donor llama in Montana, USA 2003. Use of pain relief is integral to optimising welfare while flushing and during transfer of embryos in camelids.

Figure 7. The first crop of English-born embryo transfer alpacas in 2004 (Photo kindly supplied by Rachel Hebditch).

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