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HOW TO CARRY OUT IVF ON COWS

In vitro fertilisation can produce three times the number of calves, compared with conventional embryo transfer, per breeding opportunity. **Michael Priestley** finds out how

A growing number of cattle breeders are using in vitro fertilisation (IVF) to maximise pregnancy rates. This is the process of harvesting oocytes from donor cows, and creating embryos by fertilising the oocytes with semen in a petri dish. The embryo is then implanted into a recipient (otherwise known as surrogate cow), or they can be frozen indefinitely.

Cumbria-based Paragon Veterinary Group has seen embryo production increase at least six-fold in the three years since its Activ-ET programme launched in 2013.

"We are now up to about 30-40 embryos a week in 2016 and probably see 30 as a quiet week," explains veterinary surgeon Gemma Dobson, who works at the Newbiggin collection centre, one of six Activ-ET centres around the country.

Mrs Dobson adds: "Our productivity is driven by the efficiency of the process. The more cost-effective this process is, the more affordable it becomes for breeders."



Step 1

How the procedure works step by step

The first stage is the key addition to conventional embryo transfer. Eggs are removed from the donor cow's ovary before the ovary naturally releases the oocyte down the fallopian tube.

"Using a process called trans-

vaginal recovery, IVF works by first removing the dominant follicle in the ovary, allowing the rest to grow," says Mrs Dobson.

In a normal pregnancy, the dominant follicle inhibits the rest – otherwise a cow could end up developing dozens of calves in the womb, she adds. With IVF, all follicles are left for six days to develop



Step 4

uninhibited within the ovary in a process called dominant follicle regression (DFR).

OOCYTE DEVELOPMENT

*** Step one:** Dominant follicle regression – the donor cow is given a local anaesthetic and cleaned with a mild disinfectant and saline solution. This can happen on the farm or at the Paragon facility.

*** Step two:** An ultrasound-guided needle enters the ovary to remove the dominant follicle and stimulate super-ovulation.

*** Step three:** Super-ovulation – a three-day course of follicle stimulating hormones (FSH) is admin-

IVF STAGES – FORTNIGHT TIMELINES

Donor cow		Laboratory			Recipient cow	
Day 1	Day 2 to 6	Day 7	Day 7/8	Day 8	Day 8 to 15	Day 15
DFR	Super-ovulation after three-day FSH course	OPU	Egg maturation 20-24 hours	Fertilisation	Maturation in incubator	Must be used within 24 hours if fresh in cow seven days after heat

JOHN METCALF, CROSSFELL HOLSTEINS, KIRKBYTHORE, CUMBRIA

'A good way to get more genetics out of top cows'

*** John Metcalf** is using IVF to increase the genetic merit of his pedigree Holstein herd by breeding from animals at a younger age.

He is keen to start collecting from the two full sisters of Crossfell Rubicon Milla, the highest-rated heifer in Europe on GTPI +2808 (genomic type prediction index), which sold for €75,000 (£63,000) at the Vekis spring sale in the Netherlands to Canadian breeder Progenesis.

He started the IVF programme with Paragon Vets in September

last year and by the end of May had 40 animals in-calf to IVF. He is now collecting fortnightly. This is in addition to conventional embryo transfer work. The top 5% of his 270-cow herd is selected for ET.

Calves are hair-sampled at two to three weeks old and high GTPI-rated/PLI-rated (profitable lifetime index) stock can then be placed in the IVF programme from eight to nine months of age. Current pregnancy rate success is similar to conventional flushing, at 67%.

"It's unbelievable how fast the rate of genetic gain can be, compared

with conventional flushing. If you are collecting embryos every fortnight and you can use new bulls every fortnight the rate of genetic gain is hugely increased," Mr Metcalf says.

"I go to the USA or Canada every year and noticed that breeders there were beginning to do IVF embryo transfer quite heavily. I thought it was a good way of getting more genetics out of the top cows.

"We have our own temperature-controlled facility on the farm to collect oocytes, which are maintained at cow body temperature. In the past we have also had neighbours use our

facility to collect – this is something that I'm happy to do for people in the future. Because I'm getting more progeny off my best animals our herd is benefiting from this as we are producing more efficient, high-production and high-fertility animals.

"At the minute I'm not selling a great deal of embryos; I am implanting into my youngstock here. However, in the future I will begin to have embryos available to buy from show cows and high-index animals. Advanced breeding techniques are costly, so you must target the best animals."

Sheep farming must be profitable in post-Brexit era

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Reducing fertiliser use on dairy farm with precision technology

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RECIPIENT AND DONOR MANAGEMENT ADVICE

General guidelines

- * Avoid lush, wet grass – if grazing, buffer-feed where possible.
- * Indoor recipients achieve 5-10% better pregnancy rates than those managed at grass.
- * Bought-in stock should have six weeks to settle into a new farm.
- * Ideally, recipients should be managed as a group and major changes (such as spring turn-out and autumn housing) should be avoided for six weeks pre- and post-transfer.
- * Good body condition score is essential – 2.5 minimum.
- * A long fibre-based diet of hay, big bale silage or straw should be fed.
- * Low-protein coarse mix as a supplement is preferable (although not barley).
- * Sugar beet pulp can deliver energy and fibre – and be used as a mineral carrier.
- * Routine treatments (worming, vaccination, foot trimming) should be avoided at this time.

RECIPIENT COW OR HEIFER

Cows

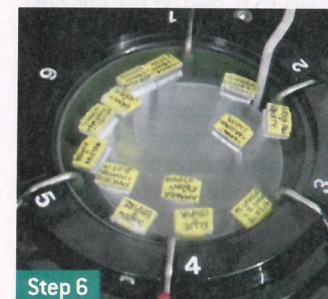
- * Cows calve easier, so the process can be preferred in beef breeding or with low calving ease bulls.
- * Works best on fourth-calvers or younger.
- * Select cows with no reproductive or health issues.
- * Synchronise cow after peak yield as stress of lactation can reduce pregnancy rates.
- * Pregnant cows can be collected from until about the fourth month of pregnancy.

Maiden heifers

- * Heifers average 5-10% better pregnancy rate, compared with cows.
- * Should be at least 15 months old, cycling regularly and weigh 350kg (depending on the breed)



Step 5



Step 6

istered to stimulate ovaries to produce more oocytes.

OOCYTE COLLECTION

*** Step four:** Ovum pick-up (OPU) – the donor cow is brought into the crush collection facility, where the temperature is at 27-32°C. Oocytes are harvested via trans-vaginal recovery, averaging 10 eggs per collection, and the eggs are matured for 20 hours.

*** Step five:** Eggs are placed into insulated chambers at 37°C to mimic a cow's body temperature.

FERTILISATION

*** Step six:** Fertilisation occurs with semen.

*** Step seven:** Resulting embryos



Step 7

are matured for a week in the laboratory, passing through eight different maturation liquids (media), mimicking the changing pH and gas levels inside the uterus.

*** Step eight:** Leave the lab – embryos can be transferred directly or frozen indefinitely.

HENRY SAVAGE, TRUEMAN LIMOUSINS, ALTNAMACKIN, COUNTY DOWN

'Our regime works well'

*** At Trueman Limousins**, where a 70% pregnancy rate is the target for heifers, success with IVF and conventional embryo transfer work hinges on diligence around three key areas – condition, nutrition and regime.

*** Condition:** Heifers must be well-fleshed but not too fat. Too much weight is an "uphill struggle" and should mean heifers are ruled out of embryo transfer work. With reference to fatness classifications on the Europ grid, Mr Savage targets 3s.

*** Nutrition:** Energy levels must be kept high, with no sudden changes in diet in the two months leading up to oocyte collection and embryo transfer.

*** Regime:** Quality semen must be used, and optimum care taken with semen and embryos to maximise conception.

IVF contenders must be mature cows with calves on grounds of exceptionally high genetic merit that may be experiencing breeding difficulties, explains Mr Savage, who runs 25 pedigree Limousins. Two cows have been through the IVF process successfully so far – a 16-year-old, from which three calves were produced, and a six-year old with a retained membrane, which produced four calves via IVF.

This summer a third dam is being put forward. She had a mummified calf inside her, of which only three-quarters was removed.

"We focus on energy levels

and a rising plane of nutrition," he says. "We have a regime we think works and we wouldn't change it. We achieved five pregnancies from seven embryos with our last recipients and generally find higher success rates with heifers, while cows, as you would expect, might manage 50% success.

"Semen quality is hugely important and the number of times the straw goes in and out of liquid nitrogen has an effect, as does having older semen – there are so many variables.

"I'm investing in a new turner for the farm this year and this is mainly because I want to produce better-quality dry silage to support cow condition and improve fertility."

SUPPLEMENTING GRASS/SILAGE IN SUMMER/WINTER

Donors: five weeks out

- * Flax oil: 50-60ml daily
- * Dried sugar beet: 1-1.5kg a head a day
- * High-energy/low-protein pre-calving nuts (40-50% maize, 14%CP): 1-1.5kg a head a day
- * Pre-calving minerals: Mixed with sugar beet and pellets or placed on to silage

Recipients: six to seven weeks after transfer

- * Broadly the same protocol
- * One difference is that double the amount of flax oil is used (100ml a head a day)
- * Cows are scanned at seven weeks and then transitioned on to standard heifer diet if pregnant

WHY USE IVF?

Benefits of using IVF

- * 50% of usual amount of semen needed. Half a straw can inseminate around six or seven donors
- * About 10 eggs per collection. About 73% of these will be fertilised
- * Then 43% will become viable and freezable
- * Fresh pregnancy rate = 58%
- * Frozen pregnancy rate = 57%

Breeding benefits

Because IVF involves the direct harvesting of oocytes from the ovary, problem breeders can be used as a donor even if they have:

- * Uterine damage
- * Blocked fallopian tubes
- * Scarring

Extend breeding life

- * Collection possible from 10 months to 20 years old and above
- * Ovaries can be recovered from abattoir