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Should you consider integrating new embryo transfer technologies into your reproductive program?

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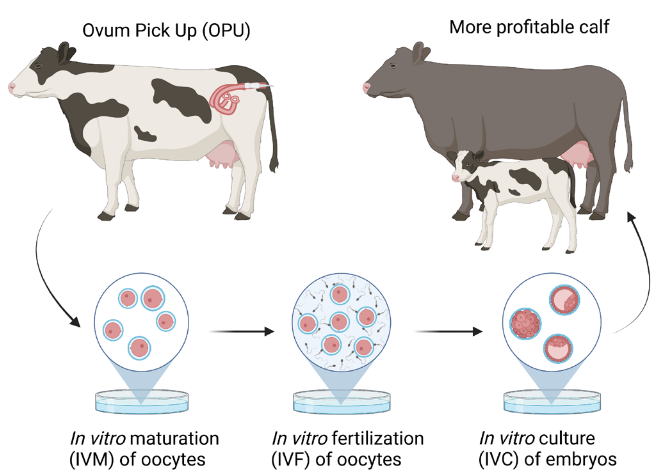
Embryo transfer (ET) is a well-recognized tool for accelerating the rate of genetic progress in cattle. This technology has been available to dairy producers since the 1970s, but there has been a surge in ETs in dairy cattle in the past 10-15 years because of the emergence of two other technologies; ovum pickup (OPU) and in vitro fertilization (IVF). The OPU procedure is used to harvest oocytes from donor cows. These oocytes are placed in culture where they are matured and fertilized, and the resulting embryos are cultured before ET (see figure for IVF overview).



These technologies are not cheap. The costs for embryo production are approximately 50-75% greater per embryo when compared with the conventional multiple ovulation embryo transfer (MOET) approach[1]. However, between 3 and 5 times more embryos can be produced when using OPU and IVF. Also, more heifers and mature cows may be used as OPU donors because ovaries can be aspirated from prepubertal heifers and pregnant heifers and cows. It also is possible to complete the OPU procedure without superovulation hormone treatments, thus enabling cattle that have weak superovulation responses to be collected.

This OPU-IVF-ET scheme first gained popularity in Brazil and Argentina primarily because of the large numbers of oocytes can be harvested from *Bos indicus* beef cattle breeds (i.e., humped, eared cattle). Fewer oocytes are recovered from dairy breeds in North America, but in recent years superovulation schemes and improved technical skills at harvesting oocytes have made these technologies a competitive alternative to MOET. The most recent survey of ET usage found that the United States and Canada are the global leaders in bovine embryo production with nearly 750,000 embryos produced, and 70% of these embryos were derived by using OPU and IVF[2].

Clearly, OPU and IVF technologies have found a home in our industry. However, this technology is still not widely used. One reason for this limited usage is price. A recent evaluation[1] found that each OPU-IVP embryo costs between $200 and $250. This cost likely will decrease as OPU and IVP practices become more commonplace in the United States. However, continued advancements in IVF procedures are also needed to increase the efficiency at producing large numbers of high-quality, transferrable embryos from each OPU donor cow.

A second reason for the limited use of these technologies is the prevalence of pregnancy losses that occur in IVF-generated embryos. My Ph.D. advisor and colleague, Dr. Peter Hansen (University of Florida), recently wrote an excellent review describing the incompletely fulfilled promise of ET in cattle[3]. In that article he highlighted the prevalence of early pregnancy losses in IVF embryos. Despite these noted limitations, IVF-generated embryos are a useful alternative to AI during periods of heat stress and in repeat-breeder cows (cows that fail to conceive after several AI attempts)[3]. Moreover, commercial vendors offer IVF-derived embryos both from genetically elite dairy cattle and from beef cattle, should one be interested in producing calves that will perform better in the feedlot and on the rail than dairy x beef crossbreds.

So, to sum things up, there are several prominent shortcomings with OPU and IVF, but these technologies have become a viable alternative to MOET for producing genetically elite calves. Continued refinements in these technologies are anticipated to improve the overall efficiency of these technologies so that transferrable embryos can be produced at a cost that is affordable to a greater segment of the dairy industry.

[1] Kimble, 2020. **https://www.progressivedairy.com/topics/a-i-breeding/reproductive-strategies-for-dairy-herd-improvement-moet-or-opu-ivf**
[2] IETS Data Retrieval Committee. **https://www.iets.org/Committees/Data-Retrieval-Committee**
[3] doi:10.1093/jas/skaa288

Raw milk: risk or reward?

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The consumption of raw milk has gained considerable popularity in recent years yet still remains a source of great debate regarding the potential health impacts. The Food and Drug Administration as well as the Centers for Disease Control and Prevention report the well-known risk for contracting foodborne disease from the presence of human pathogens in raw milk. A recent review article goes into great detail about the history of pasteurization, the prevalence of foodborne pathogens in milk and the claims associated with the consumption of raw milk (Lucey 2015). Pasteurization was developed over 100 years ago to reduce the transmission of disease through milk, in particular, tuberculosis. In 1938 it was reported that 25% of all disease outbreaks related to food/water were from milk, compared to less than 1% today. Now, tuberculosis is not a concern due to the implementation of pasteurization.

Recent surveys have reported the prevalence of pathogens to be as high as 13% for bacteria such as *Campylobacter jejuni* and *Listeria monocytogenes*. Considering it takes as little as 5-10 bacterial cells to cause foodborne disease for some pathogens, this prevalence draws great concern. Another important consideration is that raw milk can be contaminated with pathogens even when the cow is healthy and the milk appears normal. These harmful microbes can be in the gland or can come from post-harvest contamination, for example from milking equipment. This is not necessarily associated with cleanliness of the farm, whether the cows are on pasture or how often and/or how well the producer cleans the milking equipment. These are simply inherent risks associated with the production of milk.

However, despite the well-known health benefits of pasteurization, some consumers seek the purchase of unpasteurized milk, or raw milk. Consumers of raw milk report they prefer the taste, feel there are added health benefits to consuming the bacteria present in raw milk, and suggest increased nutritional value. The taste preference is an individual consumer decision. Unfortunately, we do not have objective measures for taste to evaluate this scientifically, as taste varies so greatly from one person to the next. Furthermore, consumers report the added health advantages of consuming the beneficial bacteria in milk. Although milk can contain non-harmful bacteria, the risk for pathogenic bacteria is of greater concern for human health. If consumers are interested in beneficial bacteria for gut health, they should consider products containing live cultures including some yogurts. These products contain strains considered to be highly beneficial for the gut and known to cause beneficial effects when consumed at high levels.

Another suggested health benefit of the consumption of raw milk is increased nutritional value. However, studies have reported no significant change in the nutritional content of milk following pasteurization (Andersson and Oste, 1995). Minor levels of whey protein denaturation have been shown, but that has no impact on nutritional quality. No change in the concentration of minerals occurs following pasteurization, as these are very heat stable. Pasteurization can cause a very minor loss (<10%) in vitamin B_{12}, but does not change the concentration of riboflavin (B_2) or the fat soluble vitamins including A and E (MacDonald et al., 2001). Pasture grazing can greatly influence milk composition; however, this is not necessarily associated with raw milk. There are many pasture grazed animals whose milk goes for conventional or organic sale.

Several large epidemiological studies have shown growing up in a farm environment to have protective effects against the development of asthma and allergies (van Neerven et al., 2012; Braun-Fahrlander and von Mutius, 2010; and Loss et al., 2011). Some suggest this is associated with the early ingestion of raw milk, but no scientific evidence supported this. More recently the studies have pointed to the “hygiene hypothesis” for this protective effect. The hygiene hypothesis suggests that the ingestion of low levels of healthy bacteria may help to beneficially regulate the immune system. The development of an individual’s gut microflora begins at an early age and is associated with things like type of milk consumed (breast vs. formula), can influence this development which in turn, could impact the development of allergies.

In the end, dairy producers take extreme caution to ensure the milk they sell is of the highest quality with the lowest bacterial load possible. However, raw milk is still not inherently safe to drink, despite these extreme control measures. Foodborne disease from milk can come from the consumption of only a few bacterial cells, can come from milk that looks and appears normal, can come from cows who are healthy and from farms that are clean. The beneficial health claims of the consumption of raw milk do not have scientific merit and the risks far outweigh any potential benefit. Pasteurized milk is an excellent, nutritious, and safe product containing many essential nutrients, especially for children.

Upcoming Events

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Every 1st Tuesday @ 7:30 pm

Annie's Project Course
Tuesday nights from Dec. 7 – Feb. 1 (no meetings during holiday weeks)

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In memory of Dr. Michael A. Barnes

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