Reproductive biotechnologies for the 21st century

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The reproductive biotechnology includes techniques designed to produce and preserve the domestic animals and those that are in danger of extinction or already extinct. The purpose of this study is to make a brief review about the evolution of the reproductive biotechnology and the possibility of its application and development in an immediate future.

Key words: *biotechnology, reproduction, domestic animals*

Introduction

The fast technological development and the globalization have not been favorable for the development of the abilities in developing countries, such as most of the Ibero-American countries. However, the level of scientific and technological development of a country is measured, among other things, by the resources assigned to researches and human resources. Orienting the science and technology systems towards the needs of populations is getting more important, and this way facilitating the practical feasibility of the technological innovation. Therefore, the scientific and technological productions of the region should be focused on the perception of the problems of the societies that they belong. Laws should be constituted in which the technological and scientific development is regarded as an essential factor of support for strengthening the economy and development, being this the general tendency in this field. The biotechnology contributes to the sustainable usage of the biological diversity and its preservation in the development of biotechniques of conservation and of preservation of the animal and plant species. This comes together with the economic interest, mainly at the level of domestic animals, because the goal is to increase their productivity for facing the growing demand of products of animal origin. In this sense, all the productive processes integrate elements of quality in terms of reproductive efficiency, making them more competitive over other alternatives of reproduction. This study deals with only a few of all the reproductive biotechniques developed until this moment, with their historical contribution and their application to sheep.

Development

The biotechnology for reproduction is a group of techniques, from artificial insemination up to cloning, aimed at increasing the reproductive efficiency of animals. These techniques are useful tools for the application of other more modern techniques, such as the transgenesis. The *in vivo* production of embryos gave way to the *in vitro* production of embryos, and its application included the artificial insemination and the transference of embryos as tools.

Nowadays, there is a decrease in the genetic variability of the domestic species due to the rhythm of exploitation imposed to them. Likewise, the breeds in danger of extinction and the already extinct ones are part of the programs of assisted reproduction, in order to try and achieve their resurrection, like the case of the *Capra pyrenaica* pyrenaica in Spain (Folch *et al*. 2009) or the "Tasmanian tiger" in New Zealand (Miller *et al*. 2009). Many of these techniques are systematically applied to domestic animals and acceptable results are achieved. The control of productive genes and their spreading through the use of these techniques has allowed the increase of production and quality of products in the programs of genetic improvement. However, these increases go together with the decrease of the useful life. Therefore, there are components to be taken into account from an ethical and economical point of view in the usage of these modern techniques of assisted reproduction.

According to Palma (2001), the reproductive biotechnologies are different from the genic techniques because they do not alter the animal genome. The genic or transgenic techniques are focused specifically on genes. It could be said that the biotechnology for reproduction since its very beginning has five generations (Thibier 1990). The first (1908) is the artificial insemination. The second (1970) are the hormonal control, the embryo transference, freezing and division. The third (1980) corresponds to the sexing of embryos and spermatozoids, and the *in vitro* production of embryos. The forth (1990) is identified with the cloning of the somatic cells. Finally, the fifth (2000) is the transgenesis.

In the first generation, the main motivation in the development of the artificial insemination was not the possibility of increasing the productivity, but the health

control that could be achieved through it. It is true that there was a risk that, if the necessary precautions were not taken, this would become an instrument for the spreading of diseases, either of infectious or hereditary origin. However, nowadays, about 80 millions of females are inseminated every day.

During the second generation, the record of reproduction through the hormonal control allowed to shorten the postpartum anoestrus and to restart the reproductive activity. The knowledge about the endocrine function of the hormones helped to develop the programs for the super-ovulatory stimulus and the embryonic transference, which made more effective the use of artificial insemination and concentrated the births in more homogeneous groups. These biotechnologies reached their highest development at the beginning of 1980, with an annual generation of 739,502 embryos and 227,742 of them were from Europe (AETE 2000). From this year, the third generation of biotechniques for reproduction focused their development on the sexing of embryos and spermatozoids, and the *in vitro* production of embryos. Economically speaking, the *in vivo* production of embryos is more expensive than the *in vitro* production, process in which the material is collected directly from the animals in the slaughterhouse. Together with these techniques, programs for conserving the gametes were developed, which allowed fast spreading of this material, because it was easy to transport, and it was cheap regarding the prices of the *in vivo* animals. Likewise, techniques of embryonary duplication were included in order to increase the profitability of a treatment of super-ovulatory stimulus. However, it is more systematically used nowadays.

For the forth generation, the techniques developed before were used as tools for cloning. This biotechnology allows the asexual production of an individual, which is identical to the nuclear material used to generate it (Palma 2001). The birth of the first mammal clone, originated from a differentiated adult cell (Wilmut *et al*. 1997), marked a starting point towards a future where cloning is used for the production of transgenic animals. Nevertheless, it has been criticized due to the moral consequences for the human medicine.

Eventually, all these tools are been used in the present world, known as the reproductive biotechnologies of fifth generation. The transgenesis and the gene farming or industrial production of proteins with live individuals are based on the DNA transference in a receiver cell, and the later integration and construction of that DNA in the genome of the organism. That way, if the genic construction is included in the animal genome and expresses its functions, it is known as "transgenic" and the protein encoded by the transgenic animal is called "transgenic product" (Palma 2001).

Currently, these are some examples of how different countries use the biotechnique of multiple ovulation and the embryos transference in sheep, in order to achieve specific objectives like:

- Decrease of the amount of fat from the carcass (UK)
- Increase of protein in milk (France)
- Increase of the prolificacy (Spain)
- Increase of the fertility (South Africa)
- Decrease of the diameter of wool fiber (NZ)
- Export of exclusive genetics (Australia and NZ)
- Multiplication of highly valuable animals (Mexico)

Conclusions

The qualitative and quantitative development of reproductive biotechniques since 1908 demonstrate the will of humans to develop techniques for guaranteeing the management of genes to favor the health and production of domestic animals, and those in danger of extinction. The only objective is to widen the commercial knowledge in a globalized world that tends to improve the life quality of all the living creatures in this place called "Earth".

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