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Recent developments in assisted reproduction in goats☆

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Abstract

Goats are amongst the most fertile of the domestic species. In the temperate zones seasonality may constitute a limiting factor if intensive production systems are to be employed. When conducting highly organized breeding programmes or utilizing goats as bioreactors in the context of gene pharming, assisted reproduction plays an increasingly important role. This chapter constitutes an update of recent developments in the field of assisted reproduction, including collection and handling of gametes, in vitro fertilization, oestrus control, embryo transfer, conservation and manipulation of gametes and embryos, transgenesis and pregnancy detection. Recently in some of these fields remarkable progress has been made. None the less, imperfections are remaining and sustained efforts will be required to optimize existing and invent new technologies.

Keywords: Goats; Assisted reproduction; Artificial insemination; Embryo transfer; Cloning

1. Introduction

Much of the world's goat population is found in the less industrialized parts of the world, predominantly in the rural areas of the tropical and subtropical zones with nutritionally unfavourable conditions. Provided there are no drastic shortcomings with regard to feed, health management and husbandry system, goats are amongst the most fertile of the domestic species, with conception rates in the range of 90%. Litter size varies depending on breed, season and environmental conditions. In breeds from temperate zones the natural breeding season is limited to autumn and early winter, effectuating does to kid at the beginning of the vegetation period in spring. Seasonality may act as a limiting factor if it comes to intensive production systems. An apprehensive presentation of the existing knowledge on normal reproductive functions in goats is to be found in Gall (2001). The present paper comprises a review of recent developments in the field of assisted reproduction in goats.

2. Artificial insemination

Artificial insemination (AI) is the most commonly applied means of assisted reproduction in domestic species. In countries such as France, where systematic

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genetic improvement of dairy goat populations is pursued, AI has become part of the management routine with this species. Collection of semen from male goats requires a teaser and an artificial vagina and is a fully established technique (Evans and Maxwell, 1987).

Semen processing is a much-disputed subject when cryoconservation is involved. In one opinion seminal plasma must be removed by centrifugation to protect the sperm cells from the toxic effect of lysolecithin. This substance forms as a result of an enzyme originating from the bulbourethral gland and enacts its triglyceride lipase activity (Pellicer-Rubio et al., 1997) upon the lecithin of the egg yolk or skim milk contained in the semen diluents (Chemineau et al., 1999). Other investigators, however, consider the membrane damage inflicted upon the sperm cell membrane by centrifugation to be more detrimental than the enzyme itself. They prefer to process goat semen much in the same way as bovine semen (Evans and Maxwell, 1987; Tuli and Holtz, 1994, 1995; Azeredo et al., 2001). Valuable information on this topic is compiled in Leboeuf et al. (2000).

The standard procedure of inseminating does involves lifting up of their rear quarters with their front legs remaining on the ground. With the aid of a duckbill speculum and penlight the cervical os is located and, under visual control, an insemination pipette is passed through the cervix to deposit the semen in the uterine body. Should passage of the cervix pose a problem, semen has to be deposited intracervically or caudal to the external cervical os.

When appropriately conducted, insemination of does with fresh semen yields fertilization rates comparable to natural mating. As a rule, with frozen-thawed semen poorer conception rates are observed. In France, where AI is an established component of breeding management, average conception rates of 60–65% are reported (Leboeuf, 1992; Leboeuf et al., 1998). Many other sources admit (through rarely report) less encouraging conception rates. With laparoscopic AI, in general, better and more consistent pregnancy rates are accomplished (Ritar et al., 1990; Vallet et al., 1992). This technique requires only about one tenth of the number of spermatozoa. However, laparoscopic insemination entails elaborate equipment and special skill. Animals must be fixed on a laparoscopy cradle in dorsal recumbency and are tilted into a head-down position at an angle of 45°. The abdomen is insufflated with air or an inert gas and, using a trocar, two cannulae are punched through the abdominal wall, permitting the introduction of a laparoscope and an insemination instrument. The semen is deposited in the uterine lumen by puncturing the wall of the uterine horns about 5 cm from the bifurcation with a special insemination pipette (“aspic”, Cassou, IMV, L’Aigle, France). The animals do not suffer pain but do not exactly enjoy the procedure they have to undergo.

With another technique, recently described by Sohnrey and Holtz (2005), semen is deposited deep in the uterine horns by transcervical route. Kidding rates of 71% were achieved, as compared to 53% in a control group inseminated laparoscopically. As with the conventional AI, the rear of the animal is raised and the external cervical os is located with the aid of a speculum. The lip of the cervical os is grasped with sharp-pointed forceps and, after the animal is placed back on the ground, the cervix is gently drawn toward the vulva. A catheter of 3.2 mm o.d. (Ch 10), with a stylet inserted, is passed through the cervix. The stylet is removed and, with the aid of a guiding finger located in the vaginal fornix, the catheter is advanced about 10 cm into one of the uterine horns. A polyethylene tube of 1.52 mm o.d., containing half the insemination dose, is passed through the catheter. While holding the tube in position and retracting the catheter slightly, the semen is discharged by pushing the plunger of a syringe attached to the other end. By partially withdrawing the catheter and redirecting it into the other uterine horn, the other half of the insemination dose is discharged. This technique is, of late, exclusively used for inseminating does of our own breeding flock.

3. In vitro production of embryos

In vitro production of goat embryos is a rapidly advancing field. It offers an alternative to superovulation as a source of embryos for transfer and manipulation purposes. Mature oocytes may be recovered from the oviducts of donor animals, provided not more than 5 h have passed since ovulation. Since, due to the difficulty of ovulation detection, this is impractical, as a rule immature oocytes are aspirated from punctured follicles either of slaughterhouse ovaries (Pawshe et al., 1994; Crozet et al., 2000; Han et al., 2001; Reggio et al., 2001) or from life animals by way