

ARTIFICIAL INSEMINATION: CAMELID



BASICS

OVERVIEW

- Artificial insemination (AI) is the best method for rapid genetic improvement in the herd
- AI with fresh diluted semen has been used in a variety of species and for hybridization of camelid species
- In camelids, AI with cooled or frozen semen in camelids is still an area of research
- The only studies reporting adequate pregnancy rate following artificial insemination with frozen-thawed semen were on *Camelus bactrianus*
- Camelids are induced ovulators. Artificial insemination requires timing after the induction of ovulation

INCIDENCE/PREVALENCE

- Use of artificial insemination particularly frozen-thawed semen is still limited

GEOGRAPHIC DISTRIBUTION

- Potentially worldwide if adequate techniques are developed for cryopreservation of semen

SYSTEMS AFFECTED

- Reproductive

PATHOPHYSIOLOGY

- Development of a successful AI program requires a good knowledge of the reproductive physiology patterns of these species. The most important aspects of the physiology that affect success of collection and preservation of semen and its use of artificial insemination include
 - Seasonality: although SAC are not typical seasonal, semen quality in males and follicular dynamics are affected to some degree by temperature and nutrition. Male camels are seasonal
 - Estrous cycle patterns: Ovulation is induced in camelids by the presence of a β Nerve Growth Factor in seminal plasma. Follicular waves are overlapping in absence ovulation. Synchronization of follicular wave is possible but not perfect. Ovulation has to be induced through hormonal treatment prior to insemination
 - Ejaculate characteristics: Ejaculation in camelids is a slow process (dribbling ejaculation) occurring throughout mating that last 12 to 20 minutes. The ejaculate is extremely viscous and the sperm concentration is low compared to other species. All these factors complicate semen collection and processing

HISTORICAL DATA

- Females submitted for AI can either be synchronized or teased daily to detect estrus

SIGNALMENT

- Breeding age males for collection and processing of semen
- Breeding age females for insemination

PHYSICAL EXAMINATION FINDINGS

- Females submitted for artificial insemination should be healthy and in estrus

GENETICS

- The primary purpose of artificial insemination is the introduction of new genetics and genetic improvement of the herd.
- Male selection is important to avoid introduction of potentially hereditary defects
- The primary criteria for selection of males are:
 - Dromedary camel (*Camelus dromedarius*): racing performance, milk production or show
 - Bactrian camel (*Camelus bactrianus*): various but mostly preservation of genetic diversity of the threatened species
 - Alpaca (*Vicugna pacos*): Fiber quality and production, conformation
 - Llama (*Lama glama*): Fiber quality and conformation
 - Vicuña (*Vicugna vicugna*): Preservation of genetic diversity
 - Guanaco (*Lama guanicoe*): Preservation of genetic diversity

CAUSES AND RISK FACTORS

- N/A



DIAGNOSIS

DIFFERENTIAL DIAGNOSES

- N/A

CBC/BIOCHEMISTRY/URINALYSIS

- N/A

OTHER LABORATORY TESTS

Semen collection and processing

- Semen collection is difficult due to the long duration of copulation and slow nature of ejaculation

- Semen handling is difficult because of it is extremely viscous and does not liquefy readily
- Semen can be collected by artificial vagina or electroejaculation (Figures 1, 2)
 - Electroejaculation provides adequate ejaculates if used properly. However, it requires general anesthesia and is not accepted by several breeders. In addition stimulation produces ejaculate with large amount of seminal plasma.
 - Semen collection by artificial vaginal is requires special equipment (dummy female) particularly for llamas and alpacas. Some rubber inner liners are toxic to spermatozoa. Artificial vagina used are modified small ruminant AV for SAC and modified bovine AV for camel. The primary modification is to build a system (stricture) that simulates the female's cervical rings



Figure 1: Semen collection using an artificial vaginal in a dromedary.

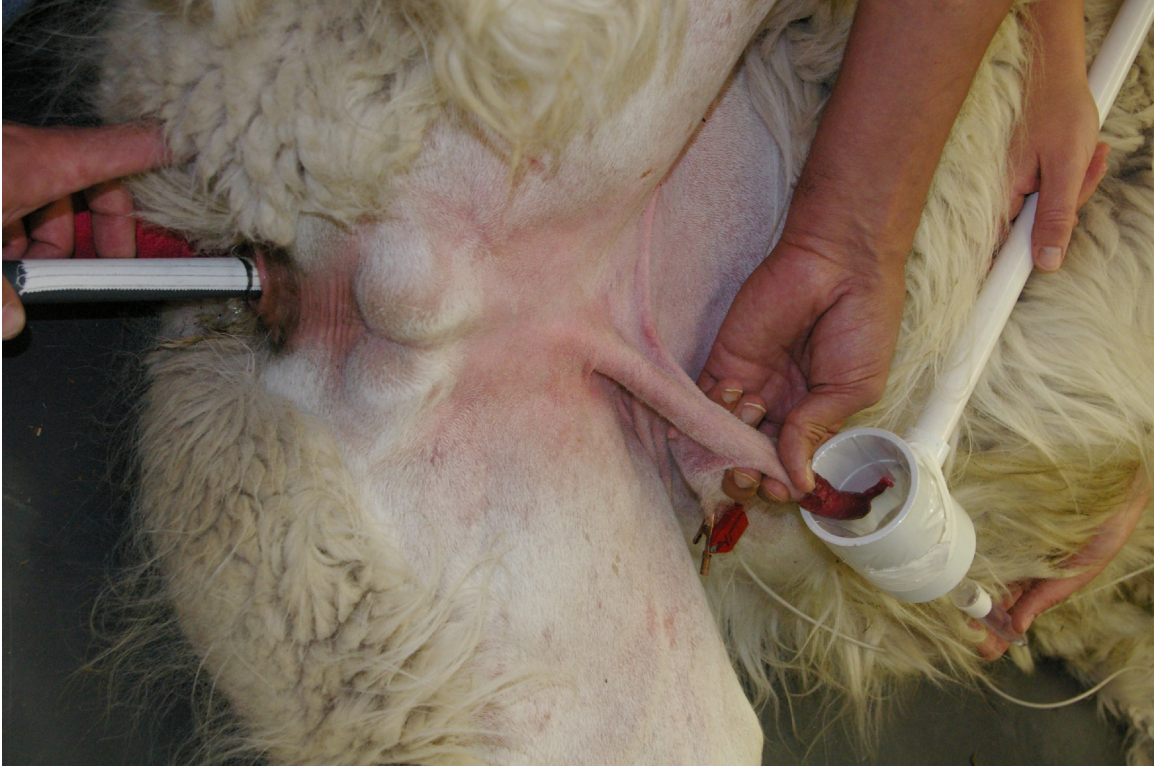


Figure 2: Semen collection by electroejaculation in an alpaca.

- Semen handling and initial quality
 - Determination of the initial quality of semen is difficult because of the presence of gel (Figures 3, 4)
 - Although described in the literature, spontaneous liquefaction of the ejaculate after incubation is not always possible
 - For complete liquefaction prior to processing, enzymes (collagenase, fibrinolysin, hyaluronidase, trypsin, papain) have to be added to extenders. These treatments may alter the function of the sperm. Collagenase and papain seem to give the best results

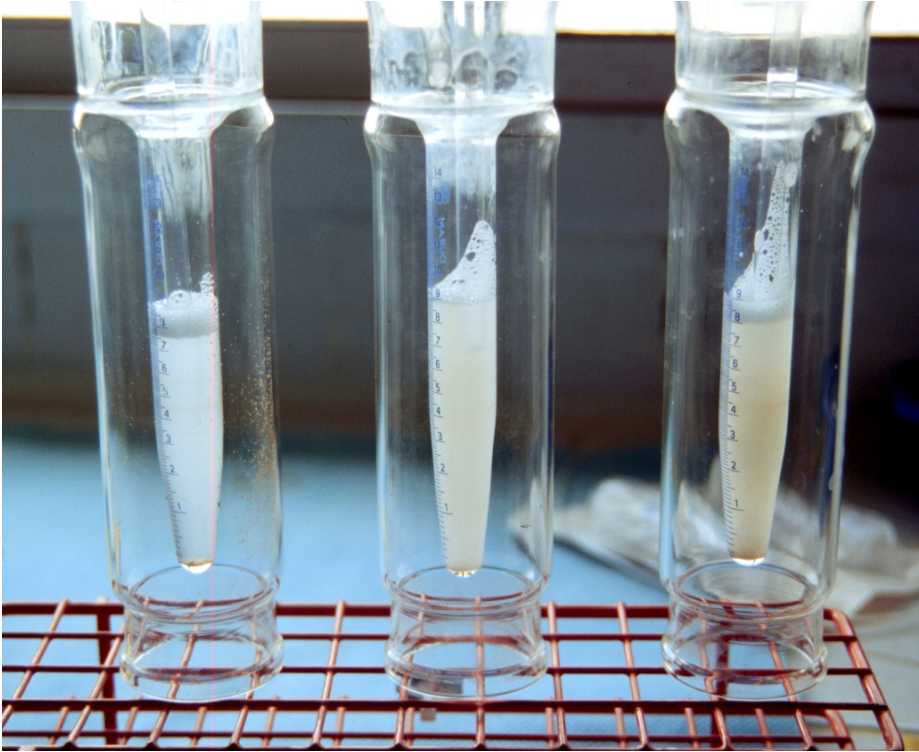


Figure 3: Dromedary ejaculates obtained by artificial vagina. Note the variation in concentration and viscosity.

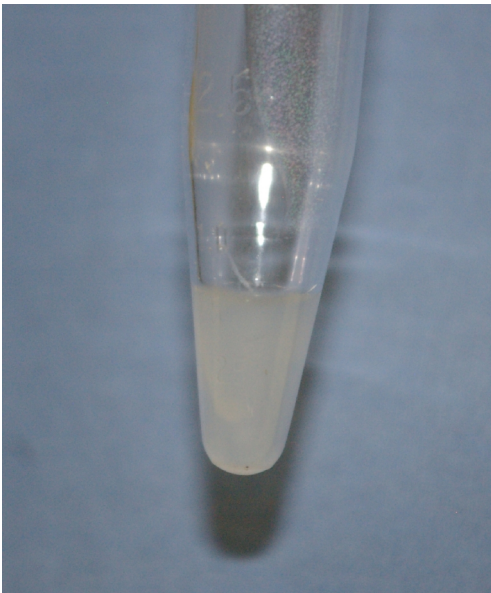


Figure 4: Alpaca ejaculate obtained by electroejaculation.

- Extenders
 - Camelid semen has been frozen successfully in Tris based-egg-yolk extenders, lactose-egg yolk, Tris citrate-egg yolk, commercial bovine and equine extender as well as new commercial camel extenders with variable results

- A special camelid commercial extender (Came green buffer® IMV International France) is available on the market and produces relatively good results with fresh or cooled camel semen
- The use of a sucrose based extender has produced the best fertility in the bactrian camel.
- SHOTOR® extender formulated for camel semen (214.6mM tris, 64.2 mM citric acid, 66.6 mM glucose, 49.9 mM fructose) seem to produced better viability
- Dilution rates are not uniform across studies.
- Addition of the cryoprotectant (glycerol or DMSO) at the end of an initial cooling seem to be better
- Semen is usually packaged in 0.25 or 0.5 ml straws and frozen above liquid nitrogen vapor at rates comparable to those used for ruminant semen
- Thawing protocols vary according to studies: 35°C for 8 to 10s, 37°C for 20 to 60 s

IMAGING

- Ultrasonography is an essential examination technique to determine the time for induction of ovulation prior to insemination and for pregnancy diagnosis after insemination

OTHER DIAGNOSTIC PROCEDURES

- Disease testing on males used for artificial insemination

PATHOLOGIC FINDINGS

- Cauda epididymis sperm has been collected, frozen successfully in several camelid species. However there no studies on its use for artificial insemination



TREATMENT

THERAPEUTIC APPROACH

- Estrus synchronization: Several techniques have been used to synchronize follicular dynamics in groups of camelids with variable results. Most inseminations are performed on females selected based determination of a presence of a preovulatory follicle by ultrasonography and induction of ovulation.
- Ovulation is induced with GnRH or hCG when the follicle reaches adequate size (8 to 12 mm for SAC, 12 to 25 mm camels)

- 90 to 100% of females will ovulate within 48 hours after treatment if they are receptive, present uterine tone and edema and follicular size is adequate.

SURGICAL CONSIDERATION AND TECHNIQUE

- Laparoscopic AI, under general anesthesia, has been used experimentally in alpacas



MEDICATIONS

DRUGS OF CHOICE

- Synchronization of estrus
 - CIDR: Progesterone 0.3 gr for deer, 1.3gr for elk
 - PGF2 α : Cloprostenol 500 μ g IM
 - eCG: IM, 200-250 IU deer, 250-400 IU elk
- Induction of ovulation
 - GnRH (IM, 50 μ g in SAC and 100 μ g in camels) or baseline (IM, 8-10 mcg in SAC, 100 mcg in camels)
 - hCG (IV, 500 to 750 IU in SAC, 1000-1500 IU in camels)

CONTRAINDICATIONS

- Appropriate milk and meat withdrawal times must be followed.

PRECAUTIONS

- N/A

POSSIBLE INTERACTIONS

- N/A



FOLLOW-UP

EXPECTED COURSE AND PROGNOSIS

Insemination techniques and conception rates

Timing of insemination

- Alpacas: 24 to 36 hours after induction of ovulation
- Llamas: 24 hours after induction of ovulation
- Camels: 24 to 30 hours after induction of ovulation

Dose of inseminate

- Alpacas: 8 million motile spermatozoa per dose as a minimum
- Llamas: dose of 12 to 50 million spermatozoa have been used
- Dromedary camel: 100 to 300 million, although acceptable pregnancy rate were obtained following insemination with 8 to 12 million sperm (fresh diluted semen)
- Bactrian camel: 1 million to 1 billion spermatozoa

Insemination techniques

- Transcervical insemination with deposition of semen inside the uterine body or deep into both horns is the most commonly practiced technique
- Transcervical insemination in the dromedary, bactrian camel and large llamas is done in the same manner as for bovine insemination (recto-vaginal technique)
- Transcervical insemination in alpacas and small size llamas is done via speculum and does not pose any difficulty if the female is receptive.
- Laparoscopic insemination has been used in alpacas. It did not show any advantage in terms of conception rate.
- Deep horn insemination on the side of ovulation seems to improve fertility. Use of flexible insemination catheter is recommended

Fertility (pregnancy rate between 35 and 60 days)

- Fresh undiluted semen: PR range from 30 to 95% (alpacas, camels)
- Fresh diluted semen: PR range from 0 to 70% (alpacas and camels)
- Cooled diluted semen: pregnancy rates range from 0 to 50% (SAC, camels)
- Frozen semen: pregnancy rates range from 0 to 95%. Chinese scientists in Bactrian camels report the best fertility with frozen-thawed semen.

POSSIBLE COMPLICATIONS

- Animals should be handled quietly to avoid any stress or accidents
- There is a risk of cervical/uterine perforation during manipulation if the operator is not experienced.

CLIENT EDUCATION

- The state of the art in camelid AI is not adequate to produce acceptable conception rate at the moment expect for direct insemination of freshly collected semen

PATIENT CARE

- N/A

PREVENTION

- N/A



MISCELLANEOUS

ASSOCIATED CONDITIONS

- Infertility and early pregnancy loss may occur in poorly managed herds

AGE-RELATED FACTORS

- N/A

ZOONOTIC POTENTIAL

- Care should be taken in handling semen collection and estrus mucus. Brucellosis, chlamydiosis, leptospirosis are a risk where they exit.

PREGNANCY

- Pregnancy diagnosis should be schedule early in order to determine conception rate from AI

BIOSECURITY

- Use only semen from males that have been tested for common infectious diseases

PRODUCTION MANAGEMENT

- Except for a few studies in the bactrian camel, the success rate of use of cryopreserved camelid semen in a production system is not yet feasible

SYNONYMS

- N/A

SEE ALSO

- Breeding Soundness Examination: Camelids
- Camelid: Reproduction
- Reproductive Ultrasonography: Camelid

ABBREVIATIONS

- hCG= human chorionic gonadotropin
- GnRH= gonadotropin releasing hormone
- IV= intravenous
- IM= intramuscular
- IU= international units
- SAC = South American Camelids

SUGGESTED READING

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