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An Invention for Easy Semen Collection from Dromedary Camels, El-Hassanein Camel Dummy (10-Apr-2003)

E. El-Hassanein

Animal and Poultry Physiology Department, Desert Research Center, 11753 El-Mataryia, Cairo, Egypt.

A camel dummy of similar features and size to a female camel in sternal recumbancy has been devised and tested in the artificial insemination center of Maryout Research Station of Desert Research Center. Using this dummy for semen collection improved the collection process and the quantity and quality of semen collected. The principles and design of the dummy in addition to its advantages are fully discussed. This invention is expected to be a revolutionary helpful tool for many specialists interested in camel reproduction and artificial insemination.

The low reproductive performance is one of the most important factors affecting camel productivity [1-3]. Factors contributing to low fertility in camels are many and complex, for example: the advanced age at puberty (3 - 4 years) and hence late age at first calving, the limited libido of males and hence limited breeding opportunities, the relatively short breeding season e.g., in Egypt, the breeding season of dromedary camels is restricted to about three months (from late November to early March), the long gestation period of 13 months and late postpartum estrus. In addition, poor pastoral management systems prevail in regions where camels are raised adversely affecting camel reproduction and productivity.

Studies carried out on slaughter house material indicated that the female dromedaries are polyestrous breeders with marked fluctuation in ovarian activity during the breeding season [4-6]. Ovulation in camels is non-spontaneous i.e., they are induced ovulators which means they normally only ovulate when mated. Graffian follicles develop in one or both ovaries reaching a mature size of between 1.3 - 1.7 cm in diameter. This mature follicular stage lasts about 4 - 6 days in general and in the absence of mating or ovulation-inducing treatment, this mature follicle will regress and another follicle will start to develop.

The ability to induce ovulation is essential for preparing female camels for artificial insemination or as recipients for embryo transfer. Mating with intact or vasectomized males will induce ovulation, and in Bactrian camels, ovulation can also be induced by intravaginal deposition of semen or seminal plasma [7], by intramuscular injection of seminal fluid [8] or by stimulation of cervix with a rubber insemination tube [9]. However, intrauterine injection of whole semen, seminal plasma, water or cloprosterol, or stimulation of the cervix with a finger for 2 - 15 minutes failed to induce ovulation in dromedaries [10]. In a previous study, ovulation was induced with Gonadotrophin Releasing Hormone (GnRH) or gonadotrophic hormones in female dromedaries exhibiting follicles of varying sizes, and the optimum time to mate or attempt to induce ovulation was shown to be when the growing follicle measures between 1.0 - 1.9 cm in diameter [11].

Development of an artificial insemination system, in combination with successful synchronization of estrus and induction of ovulation, are all necessary for applying selection programs and for more rapid genetic improvement in Egyptian camels. A well-equipped center for applying AI programs has been established (1999) at the Maryout Research Station which belongs to the Desert Research Center, Ministry of Agriculture and Land Reclamation.

Collection of semen from male camels is complicated by their natural copulatory behavior, i.e., copulation with females in sternal recumbancy, the long duration of copulation and the dripping ejaculation of the semen. During the last two breeding seasons, camel semen was collected at the AI center by electroejaculation or by artificial vagina (AV) and a female teaser. Using these two routine techniques for semen collection from camels demonstrated many disadvantages, which will be discussed later, and were not reliable for developing an AI system for dromedary camels in our AI center. Previous studies have shown that an alpaca dummy could be used to collect semen from alpacas [12] and therefore, a camel dummy was designed and constructed for easy and reliable semen collection from camels.

This chapter compares three different methods of collecting semen from male camels:
1) electroejaculation, 2) an artificial vagina and 3) the newly invented camel dummy.

Semen Collection from Camels

Semen Collection by Electroejaculation - For collection by electroejaculation, the male camel kneels down and its front legs are tied to the shoulder and neck. The male is forced to turn on its side and its hindlegs are tied together (from the shin region) to facilitate receiving semen in the rubber cone and collection tube (Fig. 1). Collection may be done with or without sedation with detomidine hydrochloride (30 - 35 µg/Kg B.W., IV, or 70 - 80 µg/Kg B.W., IM). A bovine probe (2 inches) is introduced rectally, after lubrication with jelly, and two electric impulses (each of about 12 volts and 180 mA) are applied for about 10 - 15 seconds each time with a rest of 2 - 3 minutes in between. Ejaculation often occurs after about 15 minutes of manipulation. Semen obtained by electroejaculation is often reduced in volume and has poorer quality due to the short duration of ejaculation.

Figure 1. Preparing the male camel for semen collection by electroejaculation. Turning the male on his side. - To view this image in full size go to the IVIS website at www.ivis.org . -

Using electroejaculation for semen collection from male camels has many disadvantages:

1. It consumes a lot of time and effort to collect semen from many male camels in the same day.
2. It needs sedation or general anesthesia of the animal.
3. Restraining of the male camel needs about 7 people.
4. Forcing the male camel to kneel, tightening its legs and removing ties may cause bleeding injuries and even fractures to the male.
5. It causes the male to coward and be afraid of any person approaching it.
6. Repeated electroejaculation causes inability of male to mount normally.
7. Semen collected by electroejaculation is often reduced in volume and contains a high percentage of dead and tail-less spermatozoa. It may also be contaminated with urine.

As there are so many disadvantages of using electroejaculation, it is advisable to apply this technique only under certain circumstances, such as:

1. If collection by AV cannot be achieved.
2. For collection of semen from highly vigorous males that may endanger the collection process.
3. For collection of semen from males with low reproductive potential, i.e., having week libido.
4. For collection of semen from males having certain physical problems preventing them from mounting normally.
5. For collection of semen from certain males out of the breeding season.

Collection of Camel Semen Using an AV and a Female Teaser - A bovine AV of about 40 cm in length is used satisfactorily for collection from adult males (over 10 years of age). However, for collection from younger males (less than 10 years of age), a shorter AV of about 30 - 35 cm length is needed. The jacket of the AV is filled with water warmed to about 55 - 60ºC and the hind region of the AV, in addition to the rubber cone and the collection tube, is covered with a black rubber sheath to protect the semen from light. For collection using an AV, a teaser female camel kneels in the collection yard with its forelegs tied with a rope around its neck and the hindlegs tied with a rope around its lumbar region (Fig. 2a, Fig. 2b and Fig. 2c).

Figure 2a. Collection of semen by using an AV and a female teaser. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 2b. Protrusion of the camel penis. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 2c. Directing the penis into the AV and collection. - To view this image in full size go to the IVIS website at www.ivis.org . -

If the males are young and untrained, the teaser female must be in heat. However, for collection from previously well-trained males, any female will do, as in our AI center the well-trained males mount directly on the teaser whether it is in heat or not. During the breeding season, collection from male camels is always carried out at night (at about 20:00). The northwestern coast of Egypt is characterized by the wide variation in ambient temperature from day to night during winter months. The temperature falls from about 20 to 25ºC at mid-day to about 0 to 5ºC by the onset of darkness with heavy waves of fog. Under such circumstances, male camels exhibit strong libido and seek females in heat for copulation more than during the daylight hours. It is amazing that when the males in rut notice the lights of the collection yard being turned on and the teaser female being brought in, they start to gurgle continuously, salivate more and rhythmically beat their penis with their tail. This means that they are ready for semen collection. When the door of the male pen is opened, it goes directly towards the collection yard and moves over the kneeling female until its front legs are on either side of the female's shoulders. The male starts to flex all the joints of its hindlegs to sit behind the female and pushes himself forward. The penis then starts to protrude searching for the vulval cleft of the teaser. The technician sits besides the female's hindlegs and starts to direct the penis into the AV by deviating the prepuce with gentle pressure. The male camel ejaculates in successive fractions during a series of penile strokes, which are moderated with rest phases. Copulation often lasts from 5 - 15 minutes after which the male slips sideways off the teaser female and goes directly to its pen.

Collection of camel semen using an AV and a teaser has many disadvantages:

1. Tightening and removing of ties from the teaser female may cause bleeding injuries to the female.
2. Collection from more than one male using the same female teaser in the same night often causes incised bleeding wounds on the back of the female which take about 2 weeks to heal.
3. It is not economic to keep several females without breeding just for use as teasers for semen collection.
4. Sitting of the technician besides the female's hindlegs to direct the penis into the AV often excites the male during mounting.
5. It is difficult for the technician to sit besides the hind region of the teaser female for about 15 minutes keeping his arm in a fixed position to receive the ejaculate during the long duration of copulation.
6. The technician can be exposed to biting from vigorous males during copulation. At least three persons are needed to protect the technician against sudden biting. In most cases, the male camel is excited due to the presence of many persons in the collection yard and may slip sideways off the teaser without completing ejaculation.

Principles and Design of El-Hassanein Camel Dummy

Due to the above-mentioned disadvantages of using a female camel as a teaser for semen collection, it was thought necessary to devise a tool for collection of camel semen. A camel dummy was designed with an AV inside, in the same position as the vagina of a female camel. The dummy was in the same shape and size of a female camel in sternal recumbancy and had a strong iron skeleton, with a hollow core, to withstand the weight of the male (about 400 - 500 Kg) during copulation. The iron skeleton was covered with a strong smooth wooden sheath that was the same symmetrical shape as a normal female camel and the entire dummy surface, in addition to the head and neck, were covered with a camel hide (Fig. 3).

Figure 3. A hind view of the dummy to indicate its external features and the mounted AV. - To view this image in full size go to the IVIS website at www.ivis.org . -

The dummy also had a movable head and neck. Four strong springs fixed the neck to the body of the dummy in order to facilitate the movement of the head to up, down, right and left directions. These movements excited the male camel during copulation and gave good results at ejaculation. Taking into consideration that copulation of camels takes place in a sitting position, the dummy was fixed on the floor of the collection yard which was also the ceiling of a small laboratory (Fig. 4). The technician stayed in the small laboratory underneath the dummy to exchange the AV from one male to the other and to carry out rapid evaluation and partial extension of the semen after collection. Partially diluted semen was then transferred to the main laboratory, close to the collection yard, for completing the semen processing (equilibration and freezing).

Figure 4. A diagrammatic drawing of the dummy and the small laboratory underneath. - To view this image in full size go to the IVIS website at www.ivis.org . -

Collection of Camel Semen Using the Invented Dummy - Eight male camels of about 7 years of age were used for semen collection at two-day intervals during the rutting season. They had been well trained for semen collection using a teaser female for two previous rutting seasons. On the day of collection, the small laboratory underneath the dummy was equipped with a water bath adjusted to 38ºC, a photometer previously calibrated for measuring camel semen concentration and a microscope complete with a heated stage and a control unit with a warming plate both adjusted to 40ºC. A modified AV of about 30-cm in length and 5 cm inner diameter was filled with water at 55 - 60ºC [13] and a foam imitation cervix, of about 8-cm in length, was placed inside the AV to stimulate ejaculation. A collection tube complete with glass funnel was directly fixed to the AV without using a rubber cone, as rubber is known to have a deleterious effect on camel spermatozoa [14]. The collecting tube was water-jacketed (38 - 40ºC) to keep the tube warm during the long duration of ejaculation (Fig. 5a and Fig. 5b).

Figure 5a. Internal view of the dummy indicating the mounted AV with a water-jacketed collection tube. - To view this image in full size go to the IVIS website at www.ivis.org . -

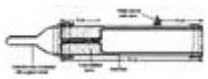

Figure 5b. A diagrammatic drawing of the modified artificial vagina. - To view this image in full size go to the IVIS website at www.ivis.org . -

As the male entered the well lit collection yard, it started to gurgle and moved around the dummy several times before flexing the joints of its hindlegs and sitting on the hind region of the dummy keeping its forelegs on either side of its shoulders (Fig. 6).

Figure 6. A rutted male camel copulating with the dummy. The male adjusted itself behind the dummy. - To view this image in full size go to the IVIS website at www.ivis.org . -

The copulating male camel started to direct and introduce its penis into the warmed AV (Fig. 7). After intromission, the male carried out several phases of movements (strokes) and rest periods throughout the long duration of copulation with continuous salivation and grinding of its teeth. During ejaculation, the screw movement of the glans penis could be easily observed in the collection tube funnel in the laboratory underneath the dummy. The glans penis of the camel is curved along its vertical plane giving a hook shape that ends in a cartilaginous process which supposedly directs the penis through the cervix of the female during copulation [13].

Figure 7. Intromission of the male penis into the AV of the dummy. - To view this image in full size go to the IVIS website at www.ivis.org . -

Comparing Results of the Invented Dummy

Using the camel dummy for semen collection improved the collection procedure in our AI center as males in rut copulated naturally with the dummy without needing any help from the technician. He could therefore stay in the laboratory underneath the dummy, throughout the collection period, to change the AV between males and to carry out rapid evaluation and partial dilution of the semen.

The duration of copulation using a female teaser ranged from 5 - 12 minutes [13] but this was increased to 20 - 45 minutes when using the dummy. Collection of semen using a female teaser usually needed about three people in the collection area to protect the technician who stayed close to the hindlegs of the teaser to receive the semen. This sometimes excited the copulating male and caused it to slip off the teaser without completing copulation. The remarkable elongation of coitus duration with the dummy may reflect the acceptance of the males to mount naturally with the well-designed dummy.

The elongation of the duration of copulation using the dummy increased the volume of the ejaculate to an average of 17.75 ml. In some males that exhibited high libido and spent about 45 minutes copulating with the dummy, more than 27 ml of semen were collected. In such cases the male must take a rest from semen collection for at least two days to avoid becoming exhausted.

The semen that was collected was highly viscous and whitish or grayish-white in color depending on the concentration and the amount of gelatinous material in the ejaculate. The problem of the high viscosity of llamoid semen has been overcome by using hydrolytic enzymes such as trypsin (1:250 w:v), for liquefaction of semen [15]. However, allowing semen to stand for about 30 minutes in a water bath sometimes achieved partial liquefaction of the semen and hence increased sperm motility. However, when 1 - 2 ml of the warmed extender was added to the collection tube before collection, the quality of the semen was significantly improved.

The results obtained by using the camel dummy compared to the use of electroejaculation or a female teaser are shown in Table 1. Results show that the volume, concentration and motility of the spermatozoa were all increased when using the dummy for semen collection compared with the other two methods.

Table 1. Comparing results obtained by the three techniques of semen collection from camels in LAIET-DRC*.

Parameters	Method of Collection			Percent Improvement obtained by using the El-Hassanein Camel Dummy	
	Electro-ejaculation	AV & Teaser	Camel Dummy	From Electro-ejaculation	From AV & Teaser Technique
Copulation Duration (min)	-	5 - 12	20 - 45	-	382
Ejaculate Volume (ml)	3.56	6.87	17.75	499	258
Concentration (million/ml)	320	370	850	266	230

Parameters	Method of Collection			Percent Improvement obtained by using the El-Hassanein Camel Dummy	
	Electro-ejaculation	AV & Teaser	Camel Dummy	From Electro-ejaculation	From AV & Teaser Technique
Motility (%)	42.8	60.2	80.3	188	133
Dead Sperm (%)	25	21	12	48	57
Abnormal Sperm (%)	22	19	11	50	58
Abnormal Acrosome (%)	15.5	12.2	7.5	48	61

* LAIET-DRC: Laboratory of AI & ET of The Desert Research Center.

The volume of the ejaculate (3.6 ml) for semen collected by electroejaculation was relatively similar to that obtained in earlier reports [13,16]. However, the volume of semen collected by AV has been shown to vary considerably. Earlier reports estimated a range of about 2 - 8.5 ml in volume [13,17-19] whereas subsequent reports estimated a wider range of between 5 - 22 ml in volume [20]. These differences may be related to the variation in libido between males.
Sperm concentration in semen collected in this laboratory by electroejaculation was about 320 x 10^6/ml which is similar to that reported previously [13]. For semen collected by AV, sperm concentration values have varied from 763 x 10^6/ml in earlier reports [17] to 256 - 440 million sperms/ml in more recent reports [13,19]. In this AI center, sperm concentrations of about 370 million spermatozoa/ml were obtained when using an AV for semen collection compared with 850 million/ml when using the dummy.

The motility of spermatozoa was increased and the other quality parameters of the semen were improved when using the camel dummy for the collecting procedure compared to the use of the AV or the electroejaculation method. The percentages of dead or abnormal spermatozoa and abnormal acrosomes in semen collected using the dummy were decreased when compared with the percentages of dead, abnormal spermatozoa and abnormal acrosomes in semen collected by electroejaculation or by using an AV and a teaser, respectively (Table 1). Improvement in the concentration and motility and a reduction in spermatozoa and acrosome abnormalities in semen collected using the dummy, may be related to the longer duration of copulation with the dummy in addition to the modification made for receiving semen directly into the glass vessel.

These results show that the values obtained for the quality of semen collected using the camel dummy exceed the normal ranges of good quality semen necessary for AI. Camel semen to be used for AI should have at least a sperm concentration of 321 - 325 million sperms/ml and sperm motility of 49.7 - 50.5%. Dead and abnormal spermatozoa and abnormal acrosomes should not exceed 18 - 19%, 27.4 - 27.7% and 8.1 - 8.5%, respectively [14,16,18,21].

In conclusion, the designing and construction of the camel dummy has overcome many behavioral constraints for collecting camel semen. The dummy proved to have a strong steel skeleton giving enough protection to the technician underneath and being covered with a hide, in addition to having a movable head and neck, it was amazingly attractive to the males for natural mating. Having the laboratory underneath facilitates rapid exchange of AVs from one male to the other and rapid evaluation and partial extension of the collected semen. Using the camel dummy improved the collection process in our AI center and increased the quantity and quality of the semen collected.

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