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REVIEW ARTICLE

Recent advances in dromedary camel reproduction: An Egyptian field experience

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Abstract

The increased importance of camel breeding in Egypt is getting obvious day after day, especially in the deserts and in newly reclaimed areas. This is mainly, due to its unique physiological characteristics which help it to survive and perform under such harsh conditions. However, it is well known that one of the major limitations in this industry is the extremely low reproductive efficiency. In our laboratory, and for more than a decade, we have conducted several studies to improve the reproductive performance of dromedary camels using modern assisted reproductive technologies. Some of these technologies were used to deal with bull camels; e.g. semen handling and processing while others were meant to manipulate the reproductive efficiency of she-camels. These include synchronization of ovulation, artificial insemination, induction of ovulation and early pregnancy diagnosis. The aim of the present review is to spot the light on recent progress in reproduction of dromedary camels (*Camelus dromedarius*) in Egypt, based on a comprehensive scientific experience for more than a decade.

Key words: Dromedary camels, Reproduction, Assisted reproductive technologies

Introduction

The dromedary camel is considered the strategic stockpile of food security in the Arabian world where about 75% of its population is raised in arid and semi-arid regions. It is considered the most versatile animal to live and perform under such harsh environmental conditions due to its unique adaptive characteristics. However, the reproductive performance of the one-humped camel is adversely affected by many and complicated natural constraints (El-Hassanein et al., 2004). This is reflected in the poor reproductive efficiency observed in this species. In Egypt, a well-equipped laboratory holding modern facilities has been established in 1998, and since then several studies have been conducted to improve reproductive efficiency of either male or female dromedary camels.

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Improving reproductive efficiency of male dromedaries

Under Egyptian environmental conditions, the breeding season of male camels (rutting) is restricted to 2-3 months during the year (from mid-December to late-February). The onset of the breeding season is mostly associated with numerous behavior characteristics display. These include the increased activity of the neck gland, the great body weight loss, the exteriorization of the soft palate (dulla), frequent urine spraying and the dirt- shiny-hip look (El-Hassanein, 2004).

Semen collection

The semen evaluation is obviously the first important step after semen collection in order to check the quality and the efficiency of semen for reproducton by artificial insemination and to test the fertility power of the reproducer. Due to the specific behaviour of male camel (siiting copulation position, long lasting mating duration), modified techniques usually used for other domestic species were developed (El-Hassanien, 2003). It consists in the use of female camel dummy having quite similar shape and position to female at mating time. An artificial vagin is placed at the bottom of the dummy.

The semen collection is done by operator placed under the dummy in more comfortable position in natural mating. This position overcomes the usual troubles occurring with natural service as female wounding and restlessness of the male. Overall, it is more safety for the operator.

Semen assessment

The initial laboratory test for evaluation of fertility in males is semen analysis. Assessment of semen in camels comprises visual inspection (ejaculate color and volume) and physical characteristics assessment (motility, live spermatozoa, morphology of spermatozoa and abnormalities) (El-Bhrawi, 2005; Rateb, 2011). Particularly, ejaculate color and volume can give a preliminary evaluation when inspecting camel semen visually. Semen color depends on the ratio of the grey gelatinous fraction to the white sperm-rich fraction. Meanwhile, average values of ejaculate volume has been reported to be highest during February (7.9 ml) and lowest during December (3.9 ml) with an intermediate value during January (5.1 ml) in fertile Egyptian camels (El-Bhrawi, 2005). He also observed individual variations among males in ejaculate volume with a wide range of a minimum 1 ml to a maximum 18 ml. Concerning semen physical characteristics, El-Bahrawy et al. (2006) reported that raw camel semen showed a wide range of sperm motility varying from zero percent (no sperm motion at all) up to 90% sperm motility with a mean of 46.7%. They also mentioned that motility assessment was expressed on basis of oscillatory movements of sperm due to the high viscosity of seminal plasma. Additionally, the average sperm concentration has been reported to be 296.76 x 10^6/ml, while average values of intact acrosome, primary and secondary abnormalities were 6.22, 6.31 and 9.73%, respectively. On the other hand, assessment of sperm biometry using a Computerized Motion Analysis System (CMA) revealed that mean camel sperm dimensions were 53 µm for sperm total length and 6.8 µm for sperm head width (El-Hassanein et al., 2004). The authors also reported that camel sperm head is more rounded in shape compared to other farm animals.

Semen processing

Due to the increased interest in applying modern reproductive technologies in camels, especially artificial insemination (AI), optimizing the semen dose has become a must. Different extenders and cryo-protectants for camel semen have been tested and evaluated for such a purpose. Semen diluents namely; tris-sucrose, tris-citrate, lactose, skim-milk, sucrose I (15% egg-yolk) and sucrose II (20% egg-yolk) have been tested and evaluated in relation to post-thaw semen assessment (El-Bahrawy et al., 2006). They reported that tris-lactose containing a final concentration of 2% glycerol recorded the highest post-thaw motility (45.8%) with the highest survival rate (73.3%). On the other hand, bacterial contamination has been reported to be another inevitable problem in camel semen processing due to the long collection time and the resemble sitting position during mating for semen collection. In order to produce an antibiotic-rich media to eliminate microbial presence in cryo-preserved post-thaw camel semen, different antibiotics, namely gentamycin and ciprofloxacin have been tested (El-Bahrawy et al., 2010). They concluded that supplementing tris-lactose extender with 400 µg ciprofloxacin sufficiently eliminated microbial contamination of camel semen without affecting post-thaw sperm physical characteristics.

The usual bad freezability, high viscosity and low post-thaw motility are among the main constraints for artificial insemination implementation in camel. For improving cryopreservation, different methods were experimented like pellets and 0.5 ml French straws. These last methods appeared more useful (El-Bahrawy, 2010). For improving viscosity, the use of Tris-Lactose extender of 3% glycerol level after centrifugation for eliminating seminal plasma viscosity appeared efficient.

Elimination of viscosity in camel semen is necessary to improve assessment of its raw physical characteristics and to provide a homogeneous dilution. To overcome this obstacle, El-Bahrawy and El-Hassanein (2009) studied the effect of five different mucolytic agents namely: α-amylase (25%), α-chymotrypsin (0.5%), trypsin (25%), sodium hydroxide (0.1 N) and bromohexine hydrochloride (0.2%) on viscosity and physical characteristics of dromedary semen. They reported that α-amylase totally eliminated viscosity and significantly improved sperm forward motility compared to untreated semen. However, these mucolytic agents had deleterious effects on acrosomal integrity after equilibration. Later, El-Bahrawy (2010) examined supplementing tris-lactose extender with five different concentrations of α-amylase (0, 2.5, 5, 10, 15µl/ml) on seminal plasma viscosity liquefaction prior freezing. He reported that adding 5, 10 or 15 µl/ml alpha-amylase to semen extender sufficiently liquefied seminal plasma viscosity and enhanced post-thaw forward motility of camel sperm without a

significant effect on either acrosomal integrity or sperm abnormalities.

On the other hand, preparing and optimizing a reliable regimen for semen collection and processing has become of great importance to be applied in camel artificial insemination centers. Recently, El-Bahrawy et al. (2011) studied the effect of collection frequency, extender and thawing temperature on motility recovery of cryopreserved dromedary camel semen. They concluded that scheduling a collection program of two semen collection times per week, then extending collected semen with tris-lactose extender supplemented with α-amylase in a rapid thawing protocol is recommended for producing high quality insemination doses.

Manipulation of reproductive disorder and sub-fertility

Although recent experience in management of camel herds has revealed phenomena of unexplained sub-fertility in males, yet research into causes of this phenomenon is rather limited and is restricted to the reproductive physiology and artificial insemination in such animals. The limited breeding opportunity, due to the short breeding season and limited libido of males, are considered the major factors contributing to low fertility in camels (El-Hassanein, 2003). Furthermore, El-Bhrawi (2005) stated that the signs of sexual behavior varied within rutting months and within individual bulls in its strength and frequency. Generally, environmental and physiological factors regulate the onset and duration of the breeding season in species that exhibit seasonality in reproduction. It is well known that testosterone is the principal male hormone which is produced by the interstitial (Leydig) cells of the male testes, and it is responsible for stimulating late stages of spermatogenesis and maintaining secondary sex characteristics and sexual behavior or libido of the male (Rateb, 2011). In dromedaries, El-Bahrawy and El-Hassanein (2011) recorded mean basal level of blood serum testosterone concentration (2.9 ng/ml) outside the breeding season, while reached a maximum value of 7.9 ng/ml at the peak of the breeding season which is reflected in the display of sexual behavior. Contrariwise, Rateb et al. (2011a) reported that concentrations of testosterone in serum of sub-fertile camels remain in a baseline level throughout the breeding season. The later authors successfully altered the disorder in reproductive hormones pattern and the abnormal behavioral and semen characteristics using gonadotropic-releasing hormone (Rateb et al., 2011b).

Improving reproductive efficiency of female dromedaries

Dromedary female camels are known as induced ovulators where coitus, so far, is believed to be the main trigger for ovulation to occur. Several experiments have been conducted to determine the optimum protocol to synchronize ovulation, induce ovulation, artificial insemination and early detection of pregnancy. In this trend, El-Hassanein et al. (2010) investigated different methods for induction of ovulation in she camels namely; natural mating, GnRH I.M. injection and intra-uterine deposition of camel seminal plasma. They concluded that, during the breeding season, 100% of naturally mated animals conceived, while estrus synchronization and ovulation induction protocols decreased conception rate to 83.3%. They also mentioned that no pregnancies were achieved after intrauterine deposition of seminal plasma for induction of ovulation. However, Khalifa (2011) studied the efficiency of a progesterone priming regimen for 10 days followed by PMSG I.M. injection (3000 IU) upon Controlled Intravaginal Drug Releaser (CIDR) removal on follicular dynamics of female dromedaries. She reported that this protocol sufficiently manipulated post-partum fertility in dromedary she-camels even during seasonal anestrous. She also mentioned that injecting she-camels with 5800 IU hCG intramuscularly was efficient for induction of ovulation when the size of the dominant follicles ranged from 1.2 – 1.6 cm. The results of her study also demonstrated that the accuracy of ultrasound for early pregnancy diagnosis in artificially inseminated she-camels reached 100% when the diagnosis was performed at 30 days following insemination. The control and induction of ovarian activity in female camel at anestrus season could be achieved with Controlled Intravaginal Drug Releaser (CIDR) and GnRH injection (Monaco et al., 2012). Such treatment stimulates ovarian activity in summer season. CIDR treatment decreases the mean follicular diameter. By combining CIDR treatment with PMSG protocol before the mating season (September), the synchronization activity is available at day 13 after treatment (Monaco et al., 2012) in both primparous and multiparous camels. However, the response to the treatment was higher with primiparous camel. Thus, when female camels loss their calf, they can be synchronized for ovulation, then inseminated

artificially as early as 37-44 days after calving (El-Bahrawy et al., 2011).

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Author Contributions

K. E. is the manager of the team and has written the main part of the paper. M. K. and S. R. are collaborators in the different field of research mentioned in the paper and have contributed to the improvement of the paper.

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