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Artificial Insemination in Camel: Problems and Prospects

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ABSTRACT

Poor conception rates in artificially inseminated camels is a metter of concern. Artificial insemination in combination with synchronization of estrous and induction of ovulation offers greatest benefit in camels. No information is available on *in vitro* and *in vivo* sperm life in processed semen at 37°C and their capacitation time. Harmonic injection at day one of estrous followed by artificial insemination 24 h later; and repeated at 36 or 48 h could increase conception rate. This strategy maximizes possibilities of improving low fertility and exploiting superior genes for milk and meat production.

Key Words: Artificial insemination; Camel; Fertility; Oestrus; Ovulation

Camel has been used mainly as a means of transport in desert and semi-desert areas. However, its hair, milk, skin and meat are the useful by-products (Williamson & Payne, 1987). In modern times, camel is an endangered and a neglected animal, mainly due to rapid replacement by fast growing alternates of transport, milk and meat. The camel possess certain physiological features that enable it to thrive in extremely arid environments and the necessity to exploit these areas may ultimately guarantee the camel's survival as a domestic animal. The search for sources of food, particularly animal protein, for the increasing human population in the developing countries with harsh environment has directed attention of the researchers to the meat and milk production potential of camel.

The world stock of dromedaries is 17 million and two million bacterians. Fifteen million dromedaries occur in Africa and Middle East and two million in Pakistan and India. Peak milk yield of 20 to 40 L per day (Knoess, 1979; Qureshi, 1986; Khanna & Rai, 1993) has been recorded for the camel. The milk yield of heavy animals may reach 12,000 L per lactation (Knoess, 1979). Daily weight gain of 1.5 kg by males and 1.0 kg by females in India and Pakistan on a low cost diet indicates that camel is an efficient meat producer (Qureshi, 1986).

One of the most important factors affecting productivity of camels, besides nutrition and disease, is the low reproductive efficiency (Nova, 1970; Mukasa-Mugerwa, 1981; Elwishy, 1987). Improvement of reproductive efficiency in the camel is essential for profitable production and to provide ample opportunities for selection and genetic improvement (Elwishy, 1987).

Artificial insemination (AI) is the proven technique for rapid genetic improvement. The Camelidae offers an advantage over other livestock for the use of AI technique being an induced ovulator. Since females demonstrate continuous estrous, they can be inseminated coinciding with induced ovulation (Williamson & Payne, 1987). There are good prospects of raising milk yields through exploitation of genetically superior semen of limited number of available males through artificial insemination.

History and scope of AI in camel. AI in camel is not a common practice for exploitation of superior genome. The first AI in camel was reported by Elliot (1961). Fernandezal-Baca *et al.* (1970a; 1970b), Novoa (1970), Chen *et al.* (1985) and Xu *et al.* (1985) have reported AI in camel (bacterian) and alpaca but mainly as a part of ovulation studies.

It is well known that Camelidae is an induced ovulator (Chen *et al.*, 1985; Cristofori *et al.*, 1989) and theoretically sexually receptive at all times. Induced ovulation if combined with ovulation synchronization offers best prospects of AI in Camelidae than other domestic livestock.

Site of insemination. AI in camel is either vaginal or uterine. The incidence of ovulations after deep vaginal and uterine inseminations were 87 and 100%, respectively, reflecting the possibility of higher fertility rate with uterine insemination. The semen should be deposited in the cranial part of the cervix or in the body of the uterus (Musa *et al.*, 1993).

Conception rate with AI. Fertility levels with cervical AI in alpacas have been rather low, being less than 25% using fresh undiluted semen. These results are attributed mainly to the poor quality of the semen (Fernandez-Baca *et al.*, 1970a; Xu *et al.*, 1985; Williamson & Payne, 1987). Ovulation failure is another major cause of low fertility. Some component of seminal plasma (not spermatozoa) induce ovulation in camel (Chen *et al.*, 1983; 1985). These authors reported that the incidence of ovulation after uterine insemination was 87%. AI in alpacas alone is not effective in inducing 100% ovulation until accompanied with hormonal induction (Fernandez-Baca *et al.*, 1970a, b).

The fertilization rate in camel is extremely low as compared with that of other domestic livestock (Novoa, 1970) being 37-53% (Yuzlikaev and Akhamediv, 1965). In most alpaca farms, 80-85% females ovulate after copulation by intact males, 75% after service by vasectomized males, 33% with AI and 100% with exogenous HCG injection. Thus it is clear that in natural breeding, fertility is low, mainly due to low semen quality and ovulation failure. The authors feel the same reasons apply for the AI.

Amount of semen and sperm number to inseminate. Much work has been done on dairy cattle and use of $10x10^6$ motile spermatozoa per insemination dose for optimal conception rate is almost universal. However , the information available on camel is limited and primarily related to ovulation studies. Frenandez-Baca *et al.*, (1970a) inseminated 1-2 ml of raw semen in to the uterus of alpacas for induction of ovulation and reported non-significant effect on ovulation. Xu *et al.* (1985) inseminated seven bacterian camels at maturation of Graafian follicles deep into the vagina using 1.2 to 4.0 ml of camel semen having 5-8 x 10^6/ml sperm cells. All females ovulated by 30-48 h after insemination. It has been recommended by Zhao *et al.* (1990) as cited by Musa *et al.* (1993) that insemination dose in the bactrian camel should contain at least 400 x 10^6 spermatozoa. The incidence of ovulation was 87%. In four females inseminated into the uterus, ovulation was 100%. These authors suggested that the least amount of semen required to elicit ovulation was 1.0 ml.

Insemination technique and equipment. The technique of rectal palpation and gynecological examination of the camel was first described by Barmintseve (1951) and later by Mobarak and El–Wishy (1971) and Arthur *et al.* (1985).

Use of long insemination tubes in the first successful AI has been reported in camel (Elliot, 1961). A disposable plastic pipette, such as used for bovine insemination (Fernandez-Baca *et al.*, 1970a,b) or a rubber insemination tube of the type used for horse AI (Chen *et al.*, 1985) inserted gently and as deeply as possible into the vagina or uterus can be used for camel insemination. However, Musa *et al.* (1993) reported that care must be taken to avoid the ejaculate making contact with the rubber liner of AV , since this affects sperm motility adversely.

For semen frozen in straws, the same type of equipment can be used as for bovines. The rubber insemination tube or insemination gun should be more than 37 cm long in relation to the length from vulva to uterine body of the camel (Djang *et al.*, 1988) or simply 42 cm long x 0.9 cm outside diameter as used by Fernandez-Baca *et al.* (1970a,b).

Unlike cattle, buffalo and other farm animals, camel is inseminated while restrained preferably in sitting position. The genital organs are normally found in the pelvic cavity (Musa & Abusineina, 1978). The presence of the cervical folds is similar to those in the mature bovine (Djang *et al.*, 1988). The cervix of camel is easily dilatable and at the height of follicular activity allows the insertion of two fingers (Musa & Abusineina, 1978), thus easing cervical by-pass during insemination.

During the follicular development, the uterus and the horns acquire some degree of tone which reaches maximum by the time the follicle matures. The changes in the tubule genital organs are most evident at the peak of the follicular growth (Musa and Abusineina, 1978) , thus helping in recognition of oestrous in camel. Problem may arise in insemination by rectovaginal technique, since rectal palpation in camel is some times difficult or even impossible due to the limited diameter of the pelvic cavity, which does not allow sufficient penetration of the examiner's arm (Schleps & Mostafawi, 1978). Another difficulty during insemination which may be encountered is identification of the cervix which has soft os-cervix unlike cattle and is not easily recognizable by palpation (Arthur *et al.*, 1985; El–Wishy, 1987). The camel cervix resembles that of cow but has five annular mucosal folds. A few centimeters behind the cervix is a concentric fringe like fold of anterior vaginal mucosa which tends to obscure the os-uteri external (Arthur *et al.*, 1985). This structure may cause difficulty in identification and location of os-uterui and passage of insemination gun through the cervix. However, the uterus is usually distinguishable because it has tonicity approaching that of bovine oestrous uterus (Musa & Abusineina, 1978; Arthur *et al.*, 1985).

In brief, with minor variations, insemination technique in camel is not different from cattle. Insemination is performed in sitting position. However, recognition and palpation of cervix may cause some difficulty but tonicity of oestrous uterus helps in palpation and oestrus detection.

Oestrus detection. Proper time of insemination is related with oestrus. The oestrus in camel can be recognized by restlessness, swelling and mucus discharge from vulva and bleating of the female (Yasin and Wahid, 1957; Novoa, 1970). Apparently, when mature follicles are available on the ovary, the female willingly accepts the male. The oestrus female seeks a male, stands besides him, becomes restless, waves her tail, and is ready to be mounted. Males seek out oestrus females by smell, usually sniffing along neck and not vulva (Williamson & Payne, 1987). On approach of a male or hearing the gurgling voice of a rutting male, the female moves her tail up and down in rapid succession (Fernandez-Baca *et al.,* 1970a; Arthur *et al.,* 1985). Occasionally some female alpacas in heat may mount other females (Williamson & Payne, 1987).

Oestrus can also be detected by the characteristic behaviour of the oestrus female and by introducing a male in the females. The time of onset and cessation of oestrus may be controlled by diurnal changes. By contrast in cattle, oestrus ceases more often in the early morning and the afternoon than during the night (Novoa, 1970). Oestrus may be detected in a herd by introducing a teaser male at night or very early in the morning.

The increasing values of oestrogens during follicular development are probably the stimuli for behavioral oestrus (Homeida *et al.,* 1988). During follicular cycle, the concentration of the serum oestradiol-17 B varies between 9 and 110 pg/ml. In early oestrus, the peak level of oestradiol (74.7±6.61 pg/ml) was maintained for three days blood oestradiol concentration average 26.8± 9.0 pg/ml when follicles are fully matured. This level decreases immediately after ovulation (Gao *et al.,* 1987).

Synchronization of oestrus, induction of ovulation and controlled breeding. Because oestrus detection has been often cited as a major factor limiting the widespread use of AI in cattle. Therefore, the elimination of oestrus detection from artificial breeding led to the research in development of prostaglandin and progestational compounds for synchronization of oestrus. The oestrus synchronization proved as useful technology for improvements in herd productivity and reproductive efficiency in cattle (Wenkoff, 1986). However its application in camel needs to be researched.

Camel is induced ovulator and offers great prospects of natural synchronization of estrous since unmated females show continuous follicular development and therefore, continuous oestrus, one would expect that all females in a herd should be in oestrus at any given time provided they have not been exposed to males, they are ready to be inseminated at any time if ovulation is properly induced. Synchronization of oestrus and induction of ovulation with gonadotrophin and progestational compounds needs research. As there is no CL in camel females except in pregnancy, therefore, prostaglandins are of no use for oestrus synchronization in Camelidae.

Optimum time of insemination. Ovulation occurs 36-48 h after mating or insemination (Chen *et al.,* 1985) which conceivably correspond to camel sperm life in the female tract. Inspite of the induced nature of ovulation in camel, the conception varies with the time of service, optimum time being the first or second day of the oestrus (Gupta *et al.,* 1978). In absence of definite evidence of the time of ovulation, it is suggested to investigate suitable service/insemination time to achieve maximum fertility.

Pregnancy diagnosis. A close relationship between corpus luteum function and the behavioral response of the females in the presence of males has been found to be an excellent means of pregnancy diagnosis in the alpaca (Frenandez-Baca, 1993). Blood or milk progesterone assays can be a valuable tool for diagnosis of pregnancy in camel. Clinical diagnosis of pregnancy in camel by rectal palpation for each month of gestation has been recommended technique for pregnancy diagnosis in the field (Musa & Abusineina, 1978; Arthur *et al.,* 1985). Ultrasonic imaging detection of pregnancy (Schels & Moustafawi, 1978). FSH-like activity in the blood of camel at about 2.5 to 7.5 months pregnancy (EI-Azab & Musa, 1976) has been reported.

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