Artificial Control of Estrus and Ovulation in Female Yaks  ( 2-Apr-2001 )

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Summary
Artificial control of the estrus cycle has provided an efficient means of increasing the reproductive capacity of yak by obviating the need for frequent visual inspection. This review describes hormone treatments for induction of estrus and ovulation, hormonal changes after estrus induction, and hormone treatments for advancement of puberty in female yaks.

Introduction
Yaks are seasonal breeders and the breeding season lasts from July to October. If the females do not show obvious estrus in a particular breeding season, they will express estrus in the next breeding season or in some cases not until several breeding season later. The observed estrus rate of yaks is rather low, and the postpartum period is long. Most females deliver calves once every two years, some of them only once every three years. Yak heifers attain puberty much later than cattle and usually first get pregnant at 3 to 4 years old [1]. Silent estrus constitutes the single largest factor responsible for poor reproductive efficiency in yaks. Aside from seasonal factors affecting the display of estrus, the most important contributing factor is an inability to detect estrus. Application of reproductive biotechnologies in the yak requires a reliable method for estrus control of female and such a method is also essential in artificial insemination or embryo transfer programs. The possibility of inducing estrus and ovulation in acyclic females and of synchronizing estrus and ovulation in groups of females offers an opportunity to increase the efficiency of yak production and to make artificial insemination more convenient. A reliable method for estrus control would benefit not only the use of artificial insemination but would also be important for establishing embryo transfer programs.

As in other livestock animals, exogenous gonadotropins in various treatment regimens have been used for estrus induction in the yak [2-4]. The effects of these treatment are, however, considerably variable. There is only limited information from field studies on such protocols. There remains a considerable need for more studies on methods to induce estrus and ovulation during acyclic periods in females yaks, either by administering of exogenous hormones and/or by manipulating environmental factors that suppress ovarian activity.

Hormonal Induction of Estrus and Ovulation
The endocrine changes occurring during the estrus cycle involve integrated interactions between hormones released by the hypothalamus, pituitary, ovaries and uterus. Each estrous cycle can be broadly divided into a follicular phase and a luteal phase, with each phase having a developmental period preceding the principal functional period [5]. In order to induce ovulation in anestrus yaks, a single follicle or group of follicles must be stimulated to develop to a state of maturity so that subsequent administration of luteinizing hormone (LH) or a hormone with LH-like properties (e.g., human chorionic gonadotropin, hCG) will cause ovulation. This approach to artificial control of the estrous cycle has provided an efficient means of increasing the reproductive capacity of yak by obviating the need for frequent visual inspection. To induce estrus using exogenous hormones treatment in female yaks, the following four points are important to consider:

1. determining the correct time of treatment,
2. achieving some degree of uniformity of the number of days from treatment to the appearance of estrus,
3. induction of estrus sufficient to permit fertile mating, and
4. efficacy with a high level of fertility.

Gonadotropins and steroids are used for estrus-induction. Either follicle stimulating hormone (FSH), in the presence of LH, or equine chorionic gonadotropin (eCG) will stimulate follicular growth. However, eCG is preferred since it has a longer metabolic half-life and is more readily available. As mentioned above, results are variable. Shui et al. [2] used a "three-in-one hormone preparation" containing progesterone, estradiol and testosterone to induce estrus in yak. However, the pregnancy
rate was only 30.9%.

GnRH and GnRH-agonists are used for estrus induction. In addition to treatment with gonadotropins, it has been possible to stimulate endogenous FSH and LH release and estrus, with subsequent spontaneous ovulation, by administering GnRH, as observed in cattle. The estrus-rate in non-milking yak-cows was significantly increased after gonadotropin-releasing hormone (GnRH) administration during the breeding season compared to control cows [6]. The results suggested that a GnRH-agonist might be effective in yaks. A single injection of luteinizing hormone releasing hormone-A2 (LRH-A, 100 µg, Ningbo Hormonal Factory, China) caused estrus in over 80% of treated anestrous yaks within 7 days, and 73.64% of these conceived [7].

Prostaglandin-F and GnRH-agonist - In non-milking yak-cows, a single injection of a combination of prostaglandin F, α (2 mg, Shanghai Wuxing Pharmaceutical Factory, Shanghai, China) and GnRH (100 µg, Ningbo Hormonal Factory, Ningbo, China) induced estrus in 78.9% of the treated animals within 7 days, and 46.7% of these conceived after artificial insemination. Compared to control cattle, the estrus and fertility rates were increased 12.3% and 13.3%, respectively [7]. The efficacy of PGF2α preparations to induce the regression of corpus luteum and inhibit the synthesis of progesterone in yaks appears to be the same as in cattle. Estrus rates in yaks treated with the PGF2α preparations Oestrophan (made in Czechoslovakia) and Enzaprost, twice at 10 day intervals, were 82.6% and 90% and the conception rates were 77.9% and 78.9%, respectively. Such PGF treatment was more effective than a single treatment [6].

Yu and Liu [3] used various exogenous hormones (LRH-A, FSH, eCG and hCG) to induce estrus in 180 female yaks of different ages. The animals included 80 milking yak-cows that had calved and had their calves with them for milking during the experiment year, 80 non-milking cows that had not calved during the experiment year; and 20 heifers. The experiment was carried out at the beginning of the breeding season. Female yaks in estrus were mated by natural service. Pregnancy diagnosis was performed through rectal examination 30 days after mating and was confirmed by delivery. After a single intramuscular injection of LRH-A (100 µg, Ningbo Hormonal Factory, Ningbo, China), the non-milking yak-cows showed the best response with an estrus rate of 95%, and yak-heifers responded better than milking yak-cows, with an estrus rate of 80%. The results indicated that the estrus rates were 82% and 88% respectively in the non-milking yak-cows after eCG (800 IU, Daqingshan Pharmaceutical Factory, Inner Mongolia Autonomous Region, China) or hCG injection (2500 IU, Ningbo Hormonal Factory, Ningbo, China). The estrus rate in the milking yak-cows reached 70% only after a combined treatment of an intramuscular injection of FSH (100 IU, Ningbo Hormonal Factory, Ningbo, China) on day 0 and LRH-A, on day 2. Estrus in treated yaks occurred within 1 to 10 days after normal treatment, with the non-milking yak-cows and heifers showing estrus earlier than milking cows [3]. While there is considerable variation in fertility after estrus induction in female yaks in this study, pregnancy rates were 86% in non-milking yak-cows and 73% in milking yak-cows [3].

Liu [9] reported the use of a potent GnRH-agonist LRH-A, (100µg, Ningbo Hormonal Factory, Ningbo, China.), eCG (800 IU, Daqingshan Pharmaceutical Factory, Inner Mongolia Autonomous Region, China) or hCG (2500 IU, Ningbo Hormonal Factory, Ningbo, China) alone or in combination with FSH (100 IU, Ningbo Hormonal Factory, Ningbo, China) administrated 2 days before the beginning of the breeding season. This treatment was successful in inducing estrus in yaks at the onset of the breeding season and increased the observed estrus rate by 30% [9]. In conclusion, a treatment regimen using LRH-A, eCG or hCG, alone or in combination with FSH during the breeding season, was successful to induce ovulatory estrus in female yaks.

Hormonal Changes after Estrus Induction

The endocrinological changes associated with the induction of estrus using LRH-A, eCG or hCG in yaks have been investigated. Injection of LRH-A, eCG or hCG alone elicited a peak release of LH within a short time and then returned to the baseline. However, LH showed a second peak where the amplitude and the time depended on category of the exogenous hormones and reproductive state of yaks. The profiles of 17β-E2 were similar to those of elicited by the second LH release, but not simultaneous, the first estradiol levels peaked before the second LH release [9].

In the early postpartum period, yak-cows were not able to respond to hormonal treatments, presumably due to a failure of the hypothalamo-pituitary axis response to the treatment. Delayed postpartum estrus and mating is the main factor determining reproductive capability in the year following calving. Injection of eCG (100 IU, Intervet, Holland) in postpartum yaks resulted in an elevation of progesterone level for a duration of 7 to 10 days which is shorter than that of the normal estrous cycle [4]. Hormone treatment may cause changes in follicles that affect subsequent progesterone production. In one study, after the treatment with LRH-A, eCG or hCG, the lactate dehydrogenase (LDH) activity in the follicular fluid, the distribution of LDH isozymes, and the percentages of A and B type of LDH changed significantly; and the ratio of LDH, vs LDH1, was reduced [9].

The in vitro effects of hormones on yak pituitary cultures have also been studied. Addition of LRH-A, eCG and hCG in the culture media of pituitary tissues could increase LH and FSH production significantly. The amount of LH and FSH released was positively correlated to the dose of LRH-A. LH release was not correlated to eCG. FSH release was the highest when 80
IU of eCG were added to the media. There were no correlations between the amounts of LH or FSH released and the doses of eCG and hCG added [10].

Control of Puberty
Puberty covers the period during which the functional hypothalamic-pituitary-gonadal relationship and interactions are being established. Yaks mature late and sexual maturity may be correlated not only with absolute age and body condition but also with other factors, such as nutrition and climate affecting the onset of the first breeding season. In an attempt to improve productivity, yak-heifers were injected intramuscularly with 100 µg of LRH-A, (Ningbo Hormonal Factory, Ningbo, China) at the beginning of the breeding season. Eighty percent of treated heifers showed estrus within 15 days after treatment while only 50% of control heifers showed estrus. Sixty percent of treated heifers were pregnant by the end of the breeding season, while only 40% of control heifers had conceived [3]. The concentration of plasma LH showed two peaks, one occurred from 10 to 4 days before the first estrus, and the second on the day of estrus. LH then decreased to baseline levels after estrus [11]. When both ovaries were removed in normal yaks before puberty, the concentration and release frequency of LH increased significantly, while its amplitude decreased. The LH concentrations remained high similar to levels in ovarioctomied yak heifers treated with progesterone (20 - 30 mg, Suzhou Hormonal Factory, China) and estradiol-benzoate (2.5 - 3 mg, Shanghai Hormonal Factory, China), returning to levels before ovariectomy when animals showed signs of estrus [12].

Conclusion
Treatment with exogenous hormones is a useful method for reducing the interval from parturition or puberty to conception in female yaks, and for improving reproductive efficiency during the breeding season. Artificial control of estrus can reduce management problems associated with daily estrus detection in large or small herds, especially in the presence of suckled calves and anoestrous cows. The current knowledge of basic patterns of follicle development in yaks is insufficient to develop and apply protocols for induction of estrus. The induction of estrus would be a useful tool to study the process and patterns of follicular dynamics in yaks. The data obtained from such basic studies may then be used to develop test models for enhancing reproductive efficiency.

References

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