Superovulation of Boran Cattle in Ethiopia: A Preliminary Report

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Summary and Implications

The reproductive response of 27 Boran and 20 Boran x Holstein cows to an exogenous superovulation treatment regimen was investigated. Upon cessation of treatment, cows were monitored to determine the onset and duration of estrus. Superovulatory response was by assessed via both transrectal palpation and ultrasonography. The overall proportion of cows that exhibited estrus was 77% and was higher (P=0.003) for Boran than for Boran x Holstein crosses. The mean interval from CIDR removal to the onset of estrus was 20.4 ± 1.8 hours, and the mean duration of estrus was 21.9 ± 1.1 hours. The method (palpation vs ultrasound) used to determine the number of corpora lutea (CL) gave similar results (P>0.10; 8.5 and 8.6, respectively). Boran cows had a higher (P<0.03) number of CL (10.1 ± 0.8) than Boran x Holstein crosses (7.2 ± 1.1). These preliminary results indicate that superovulation of purebred Boran cattle is feasible and provide encouragement for use of embryo transfer technologies in the preservation of this endangered breed.

Introduction

The Boran is one of four indigenous cattle breeds in Ethiopia designated as endangered by the United Nations Food and Agriculture Organization (FAO). This breed is well-adapted to arid and semi-arid conditions, and loss of this breed could reduce options for dealing with climate change and increasing milk and beef production in those regions.

The Boran is a *Bos indicus* cattle breed, and under ideal management conditions it is generally accepted that *Bos indicus* cattle are less fertile and have lower levels of milk production than *Bos taurus* breeds; however, *Bos indicus* breeds typically are better adapted to harsh environmental conditions and therefore are more likely to reproduce successfully. Fundamental biological differences in reproductive function between *Bos taurus* and *Bos indicus* cattle have been reported with respect to age at puberty, estrous cycle patterns, estrous behavior, acquisition of

ovulatory capacity, ovarian structures and reproductive hormone production. The main physiological differences include: higher circulating concentrations of ovarian steroid hormones (e.g., estradiol and progesterone), larger population of small diameter ovarian follicles, and smaller size of the dominant follicle at deviation in *Bos indicus* compared with *Bos taurus* cattle.

Embryo transfer (ET) technology is widely used globally in the cattle industry, with more than ½ million embryos transferred annually. Superovulatory treatment of donor cows enables production of a higher number of transferable quality embryos and higher probability of producing multiple offspring. Variability in the response to superovulatory treatments seems to be affected by breed, and the dose of exogenous FSH required for superovulation of *Bos indicus* cattle is typically 30% less than that for *Bos taurus* cattle.

In spite of extensive research conducted on the reproductive physiology of *Bos indicus* breeds in some regions of the world, studies on bovine reproductive physiology in other parts of the world are less numerous. One such *Bos indicus* breed that has not yet been fully characterized is the Boran.

The objective of this study was to assess the effect of follicle stimulating hormone (FSH) dose on the superovulatory response of purebred Boran and Boran x Holstein crossbred cows raised under semi-tropical conditions in Ethiopia.

Materials and Methods

The experiment was carried out at the Debre Zeit Agricultural Research Center (DZARC) of the Ethiopian

Institute of Agricultural Research (EIAR) dairy cattle improvement farm, located about 45 km east of Addis Ababa (8°46′13.57"N, 38°59′50.45"E; 1900 meters above sea level). The average annual temperature for the last five years was 18.5°C with an average annual rainfall of 757 mm.

A total of 47 cows between 6 and 8 years of age with an average body condition score of 7.0 (range 6.0 to 8.0) on a scale of 1 to 9 (1= emaciated to 9=obese) were selected as donor cows after passing a thorough gynecological examination. All cows were managed under similar housing and health management. Both groups of cows were fed tef (*Eragrostis tef*) straw and grass hay as a basal diet that was supplemented with commercially prepared concentrate feed (wheat bran, wheat middling, corn, Noug cakes [oil seed cake = *Guizotia abyssinica*], and mineral salts). Cows were provided water *ad libitum*.

Group I consisted of 27 purebred Boran, and Group II consisted of 20 Boran x Holstein crossbred cows. Cows in each group received a CIDR (1.38 gm progesterone, DEC International NZ Ltd) for seven days. On Day 4 of CIDR treatment, cows were allotted within genotype to one of three superovulatory treatments: 200 IU, 250 IU, or 300 IU (Pluset®, Barcelona, Spain). The FSH was given as a series of eight intramuscular injections administered each morning and afternoon in a decreasing dose regimen. All cows received 2 ml of i.m. cloprostenol (Estrumate®, Schering-Plough BPK) on the sixth day of CIDR treatment, and the CIDR was withdrawn on 7th day at 6 PM. For 84 hours after CIDR removal all cows were meticulously monitored to determine the onset and duration of estrus. All cows that showed behavioral estrus were inseminated twice with Boran semen purchased from the National Artificial Insemination Center of Ethiopia. The number of corpora lutea (CL) present on each ovary was determined seven days after estrus via transrectal palpation and ultrasonography. Superovulation was considered successful if a cow exhibited estrus and possessed more than one CL at the time ovaries were examined.

For the binary response variable of estrus/no estrus, data were analyzed via Chi-square. Data on the onset and duration of estrus were analyzed via analysis of variance (IBM® SPSS® Statistics 20). Mean separations were performed using the least significant difference test of the generalized linear model procedure.

Because this was a pilot experiment on the feasibility of superovulating purebred and crossbred Boran cows, non-surgical embryo recovery was attempted on only a few donors. Therefore, embryo recovery data are not reported.

Results and Discussion

The proportion of superovulated cows that exhibited estrus was 77%, and the incidence of estrus was higher (χ^2 = 9.057; p=0.003) in Boran (93%) than in Boran x Holstein crossbred cows (55%).

For those cows that exhibited estrus, the mean (± SEM) time interval from CIDR withdrawal to the onset of estrus was 20.4 ± 1.8 hours, and this interval was not affected (P>.10) by genotype. The mean duration of estrus was 21.9 ± 1.1 hours and was not affected (P>.10) by genotype.

The mean (±SEM) number of CL counted manually and ultrasonographically was 8.5 ± 0.9 and 8.6 ± 0.7, respectively, and did not differ (p>.10) by method. The maximum number of CL counted on any individual female was 17, and this was detected in a Boran cow stimulated with 250 IU.

Boran cows had a greater response to superovulation than Boran X Holstein cows. The highest mean number of CL was achieved in Boran cows superovulated with 250 IU (14.0 ± 1.8), whereas the greatest number of CL in Boran X Holstein cows was attained with a superovulatory dose of 300 IU (8.0 ± 1.5). A genotype by FSH dose interaction was not observed.

In the present study the ovarian response of purebred Boran cows to a relatively low dose of exogenous FSH was quite acceptable and gives strong encouragement for future studies of the production of *in vivo* derived preimplantation embryos from this breed. Further research on factors impacting the response to superovulation (e.g., nutritional status, reproductive history, age, season, breed, ovarian status at the time of treatment, repeated superstimulation) are needed for the Boran breed. It is important to preserve the Boran breed in a pure state as this breed is well adapted to the harsh environmental conditions of Ethiopia and other parts of east Africa.

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