

THE ECONOMIC VALUE OF EARLY CYTOGENETIC TESTING OF POTENTIAL CATTLE BREEDING STOCK

There are three principal non-infectious pathologic conditions of cattle, relating primarily to reproduction, which can be economically diagnosed cytogenetically at birth.

INTRODUCTION
Structural and numerical flaws develop periodically in chromosomes in animals during the complicated meiotic and mitotic processes involved in sperm and egg formation. These result in lowered fertility as well as other body problems. In contrast to the US, it has been a long established custom in Europe and other foreign countries to test young stock early on for these cytogenetic flaws. In light of the continued shrinkage of the cattle genetic pool and increase in presale cytogenetic certification requests, it is important for those engaged in the cattle industry to be aware of the need for selective early cytogenetic testing.

In over 35 years of cytogenetic testing of bovine samples we have encountered numerous cases where early cytogenetic testing would have saved owners considerable money and time. In our poster presentation we show color-enhanced diagrams of the main cytogenetic flaws that occur, many individual cases we diagnosed that resulted in avoidable economic losses to owners, and results of some of the national surveillance testing we engaged in following our diagnosis of genetic flaws in samples submitted from breeding stock. This will include primarily Simmental, Charolais, and Holstein-Friesian breeds.

Also included are the results of our study of vaginal length vs. cytogenetic diagnosis in Freemartinism, using a probe we developed for on-farm diagnosis of this condition.

1. Freemartinism

CONJOINED CHORIONIC VESICLES OF HETEROSEXUAL TWINS

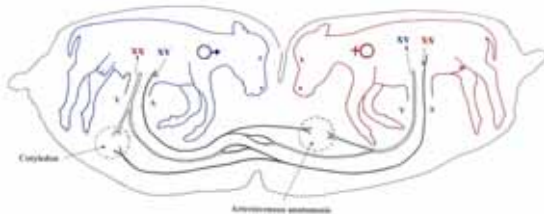


Figure 1. Diagram showing exchange of blood between conjoined twins

If blood vessels of twins become conjoined between their placentas early during fetal development, hormonal substances of the male come across and prevent the normal development of the female's genital tract. Records show that approximately 90% of females born co-twin to a bull will be sterile, a condition known as freemartinism. *(The term 'freemartinism originated in England where non pregnant (free) heifers were sent to market if not pregnant by St. Martin's day, early in November.)*

The freemartins and also the normal calves can be diagnosed on the farm by use of a calibrated vaginal probe. Freemartins usually have a vulvo-vaginal length of 7 cm. or less. Normal calves usually will have a vulvo-vaginal length of 14 cm. or greater. Females with vulvo-vaginal lengths of intermediate dimension can be diagnosed cytogenetically.



Figure 4. Obvious Freemartin since the vagina is absent

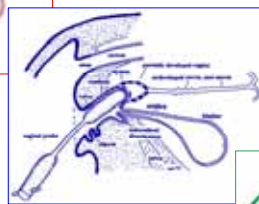
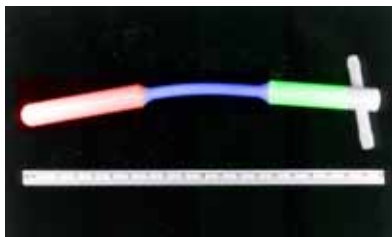


Figure 5. Probably Freemartin, though some vaginal development is present



Figure 6. Non-Freemartin since normal vaginal development is present

Figure 7. Vaginal probe



The vaginal probe is divided into three equal 7 cm segments, which relate to three possible diagnoses: freemartinism, questionable, and non-freemartin. The initial and terminal 7 cm thick portions of the probe allow for easy and reliable identification of freemartin and non-freemartin cases. All measurements obtained in the thin 7 cm mid-portion indicate the need for laboratory diagnosis. The curved shaft and terminal handle facilitates easy insertion and withdrawal of the probe.

Two lymphocyte chromosome spreads from a blood sample obtained from a freemartin calf. The calf had female (left) and male (right) Chromosome spreads. (Color added for emphasis.)

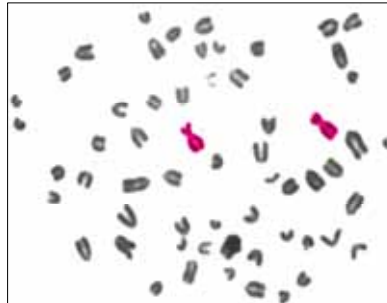
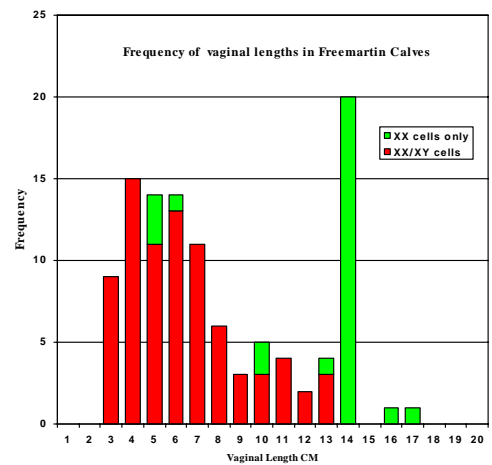


Figure 2 - Female Cell



Figure 3 - Male Cell

Figure 8. Preliminary data on vaginal length values of heterozygous co-twin heifers, newborn to 2 months of age as related to cytogenetic diagnosis for freemartinism using the vaginal probe.



These data suggest that heifers with vaginal lengths of 7 cm or less can be diagnosed on the farm as freemartins, and those with vaginal lengths of 14 cm and above as non-freemartin. The remainder with intermediate values then would require laboratory (cytogenetic) diagnosis. The finding of occasional non-freemartin cases with vaginal measurements of 7 cm or less may result from several reasons, one of which is the presence of a partial hymen that restricted the passage of the vaginal probe.

References:

Zhang T, Buoen LC, Seguin BE, Ruth GR, Weber AF. Diagnosis of freemartinism in cattle: the need for clinical and cytogenetic evaluation. J. Am. Vet. Med. Assoc. 1994 May 15;204(10):1672-5.

Bongo TA, Jainuden MR, Lee JYS. Testicular hypoplasia in a bull with XX/XY chimerism. Cornell Vet 1981;55:637-44.