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Research Article

Reproductive and Economic Efficiency of Two Fixed-Time Insemination Protocols for Gyr Cattle Under Tropical Conditions

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Abstract

The objective of the research was to evaluate the reproductive and economic efficiency of two protocols (estradiol benzoate - EB and estradiol cypionate - EC) of fixed-time artificial insemination (FTAI) in Gyr cattle under tropical conditions. The presence of estrus and pregnancy percentage in 22 dairy Gyr cows were evaluated. It was registered that 100% of the cows presented estrus and 45% pregnancy for each treatment. No differences in pregnancy were found between treatments, however, protocol II based on EB generated more costs. In this sense, the application of EC as an ovulation inducer should be applied to perform FTAI because it has the same efficiency and is less expensive, it would help sustainability and improve the profitability of the farm.

Keywords: *Estrus Synchronization; Pregnancy Rate; Reproductive Efficiency; Gyr Bovine; Tropic; San Martín*

Introduction

Infertility in cattle herd becomes a pathophysiological condition called "reproduction and production disease" and with the lack of unplanned technical management it has been spreading in livestock activity [1]. Infertility, by affecting the productive performance of the herd, also negatively affects the return on investment in livestock. That is why, the efficiency of reproduction constitutes an important and crucial role in the productivity and profitability of livestock activity [2]. Currently, the use of different protocols for estrus synchronization are based on the use of progestogens, for example, intravaginal devices that contain progesterone for the synchronization of estrous cycle, is one of the most used [3]. Despite strategic planning and the use of these agents that allow estrus to be synchronized, the results obtained by implementing artificial insemination programs, in terms of fertility after estrus synchronization, are still low [4].

Reproduction and its management form a component of economic importance for the success of the dairy activity. The detection of estrus in time is vital for production programs of calves per cow, liters of milk per cow and kilos of meat per cow [5], and the incorrect detection of estrus is related to the loss of economic benefits due to the time intervals between births, higher cost investment in veterinary products, labor, among others [6]. In cattle, as in all species, reproductive life is described as the time from first calving to death. Dairy cows typically produce milk 80% to 90% of their time and the remaining time is called the dry period when they prepare for their next calving. In countries specialized in the dairy industry, the useful life of a cow is from 2 years to 6 years, however, there is a natural life expectancy of dairy cattle that is up to 20 years [7].

In addition, in order to improve the response of protocols for obtaining estrus with intra vaginal device, the application of other hormones such as gonadotropin-releasing hormone, equine chorionic gonadotropin, and estradiol has been implemented [8,9]. However, at the level of the Peruvian tropics, there is still this deficiency of response information to estrus synchronization protocols in bovines of *Bos indicus* descent. The works carried out are scarce and more information is still required in this regard, particularly in *Bos indicus* cattle under tropical conditions. In this sense, the research objective was to evaluate reproductive efficiency in Gyr cows through the application of two protocols with estradiol under tropical conditions.

Materials and Methods

Geographic location

The research was carried out at the Estación Experimental Agraria el Porvenir (EEA - El Porvenir), Instituto Nacional de Innovación Agropecuaria - INIA, district of Juan Guerra, province and department of San Martín, Peru, located at 6° 35' 49" S and 76° 18' 55" W, at an altitude of 229 meters above sea level, with average annual temperature of 26°C and average annual rainfall of 1337 mm.

Animal handling

The experiment was carried out from November 2 to 12, 2020 and worked with 22 multiparous Gyr (*Bos indicus*) females aged between 5 and 9 years, with body condition 3, on a scale of 1 to 5, where 1 represented slender animals and 5 indicates obese cattle [10]. The cows were kept under grazing conditions 24 hours a day with *Brachiaria decumbens* grass and received a feed supplement of 1 kg of commercial feed with 17% protein and water was supplied *ad libitum*.

Protocol implementation

To the 22 cows on day zero, an intravaginal device (DISPOCEL max) of 1.2g of natural progesterone was placed, and 2 mg of estradiol benzoate was applied intramuscularly. On the eighth day, the device was removed and subdivided into two groups of 11 cows each. Group I received 25 mg of prostaglandin F2α plus equine chorionic gonadotropin and 1 mg of estradiol cypionate, and to group II, 25 mg of prostaglandin F2α plus equine chorionic gonadotropin was applied. On the ninth day, group II received a dose of 1 mg of estradiol benzoate intramuscularly. Finally, on the tenth day, artificial insemination was performed at a fixed time in both groups (Figure 1).

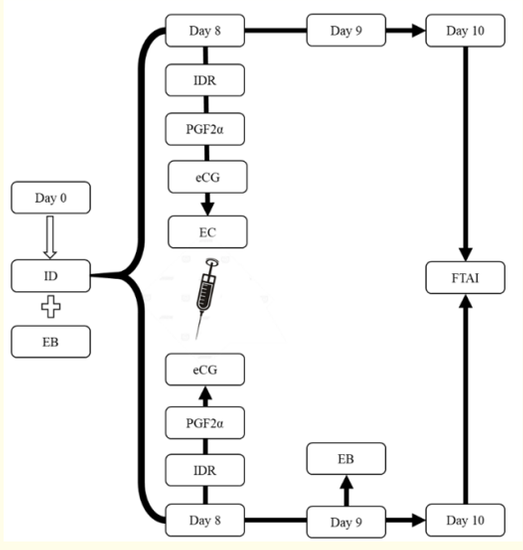

Figure 1: *Protocol description. ID: Intravaginal Device, EB: Estradiol Benzoate, IDR: Intravaginal Device Removal, PGF2α: Prostaglandin F2α, eCG: Equine Chorionic Gonadotropin, EC: Estradiol Cypionate, FTAI: Fixed-Time Artificial Insemination.*

Estrus detection, FTAI and pregnancy diagnosis

The detection of estrus was through the use of mounting detector patches or labels, which were pasted on the rump of each cow. The patch has a characteristic gray color and is discolored by the mounting action of other animals and shows a fluorescent color indicating the time to perform fixed-time artificial insemination (FTAI). The IATF was performed approximately 54 hours after removing the intravaginal device, a dose of frozen-thawed semen of 0.5 ml was applied. Pregnancy diagnosis was made by transrectal palpation 60d after insemination with ultrasound (Dramiński® ultrasound scanners, Poland) and the presence or absence of developmental structures of an early gestation fetus was identified.

Economic analysis

The cost of artificial insemination was determined based on the price of the hormone doses and the labor of the technician.

Data analysis

The data were evaluated through a descriptive analysis to determine the presence of estru and pregnancy percentage.

Results and Discussion

In this research it was evidenced that all the cows showed estrus after application of the protocol treatment (estradiol benzoate and estradiol cypionate). These results are in agreement with the reports of Pérez., *et al*. [11], who studied the response of two protocols in the gestation of the Caqueteño Creole breed, but differ from the findings of Peralta., *et al*. [12], who carried out the study in commercial Brahman cows, reported percentages of females in estrus of 79% and 72% estradiol benzoate and estradiol cypionate. The differences in response to the application of treatments could be due to the physiological response of each breed, type of food and agroclimatic conditions in the areas where each animal is raised [13,14]. When postpartum cows are induced to ovulate with estradiol cypionate or human chorionic gonadotropin for artificial insemination programs, injection of cypionate has been observed to increase the percentage of cows showing estrus after removal of the intravaginal progesterone device. In this sense, the expression of estrus is very important and it is stimulated by increasing estradiol concentrations at a time when progesterone is low. Effects that occur in the preovulatory period such as the expression of estrus, induction of gonadotropin peak that induces ovulation, and sperm transport can occur due to preovulatory secretion of estradiol by a dominant follicle that affects important physiological processes for the establishment of pregnancy [15].

The pregnancy rate is detailed in figure 2. In general, of the 22 cows, 45% became pregnant and 55% did not respond to the protocol, likewise, 45% pregnancy was found for each treatment. The results of this study were lower than those reported by Pfeifer., *et al*. [9], who evaluated the analogous effect of prostaglandin F2α on pregnancy rate in crossbred Aberdeen Angus cows and reported a pregnancy range of 54.9% to 55.1% for cows treated with estradiol cypionate and estradiol cypionate plus prostaglandin F2α, respectively, however, they also found no differences between treatments. Previous studies indicate that prostaglandin F2α acts primarily through a local mechanism, requiring a higher developmental stage of preovulatory follicles compared to the action of estradiol cypionate [16]. In Gry-Holstein crossbred cows, when comparing estradiol benzoate and prostaglandin F2α as ovulation inducers, values of 40.7% and 38.2% were found for estradiol benzoate and prostaglandin F2α, respectively [17], these values were lower than those recorded in this study.

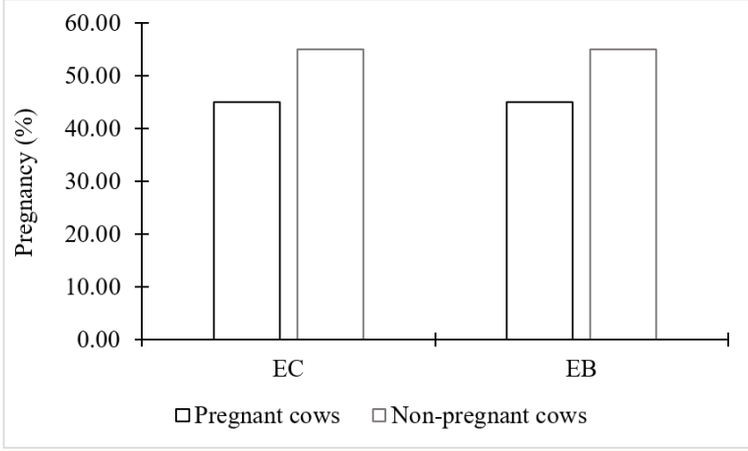

Figure 2: *Percentage of pregnancy of Gyr cows applying two types of protocol. EC: Estradiol Cypionate, EB: Estradiol Benzoate.*

The economic efficiency of protocols used is detailed in table 1. A higher cost was recorded when using BE (251.43 soles/cow) compared to CE (225.58 soles/cow). The higher cost of BE protocol could be due to the use of labor for technician and labor for the confinement of cows and for second dose of BE on day 9. When applying BE in the IATF protocol, it increases by 25.85 soles per cow. When comparing the pregnancy percentage between protocols, we found no differences between treatments, so it is advisable to work with CE to perform FTAI because it would reduce the cost of the protocol and reduce stress in the cows.

Estradiol cypionate				
Input	**Unit**	**Quantity (dose/cow)**	**Unit price (S/.)**	**Sub-total (S/.)**
ID	Unit	1.00	45	45.00
EB	mg	2.00	0.93	1.86
PF2α	ml	0.01	2.25	0.02
eCG	ml	2.00	25	50.00
EC	ml	1.00	1.7	1.70
UL	Hour	0.30	40	12.00
SL	Hour	0.30	50	15.00
IS	Dose	1.00	100	100.00
Cost per cow (S.)				225.58
Total cost of treatment (S/.)				2481.4075
Estradiol benzoate				
ID	Unit	1.00	45	45.00
EB- first dose	Mg	2.00	0.93	1.86
PF2α	ml	0.01	2.25	0.02
eCG	ml	2.00	25	50.00
EB- second dose	mg	1.00	25	25.00
UL	Hour	0.36	40	14.55
SL	Hour	0.30	50	15.00
IS	Dose	1.00	100	100.00
Cost per cow (S.)				251.43
Total cost of treatment (S/.)				2765.71

Table 1: *Economic efficiency of two protocols for fixed-time artificial insemination.*

ID: Intravaginal Device, EB: Estradiol Benzoate, ID: Intravaginal Device, PF2α: Prostaglandin F2α, eCG: Equine Chorionic Gonadotropin, EC: Estradiol Cypionate, US: Unskilled Labor, SL: Skilled Labor, IS: Imported Semen.

The evaluation of different protocols allows optimizing the investment costs for production of bovines, this allows a greater number of pregnancies per cow and therefore the greater the economic value of each cow [19]. To maintain and improve the productivity per unit of time of the cattle herd, it is necessary to reduce the costs in each reproductive stage of the cow [5]. An important economic component is reproductive management, which includes the costs of protocols, detection of estrus, technical expertise, good balanced nutrition in nutrients and animal welfare [19].

Conclusion

The results of this research suggest that the use of estradiol cypionate in estrus synchronization protocols increases the pregnancy rate by fixed-time artificial insemination as well as estradiol benzoate in Gyr cows. In this sense, the application of cypionate could be used successfully to induce ovulation in *Bos indicus* cattle because it is less expensive compared to the use of estradiol benzoate.

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Conflict of Interest

The authors declare that they have no conflict of interests.

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