Comparative Efficacy of Estrus Induction Protocols Using PGF2α Alone Versus OvSynch and Select Synch in Dairy Cattle in Algeria

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ABSTRACT

The objective of this study is to evaluate the efficacy of estrus induction protocols based on PGF2α in comparison with an OvSynch-type variant and the Select Synch protocol in terms of reproductive performance in dairy cows in Algerian farms. A total of 105 cows, aged 2 to 5 years, including 39 primiparous and 66 multiparous, of Montbéliarde (66) and Holstein (39) breeds, and gyneco-clinically intact, were divided into three groups. In the first group, cows received two injections of PGF2α at an 11–14-day interval, with a dose of 25 mg per cow of Dinoprost®. In the "OvSynch" and "Select Synch" groups, cows were treated with an injection of 100 µg GnRH (Cystorelin®) on day 0, followed by an injection of 25 mg PGF2α (Dinoprost®) on day 7. Only the "Select Synch" group received a second injection of 100 µg GnRH on day 9. Cows were inseminated based on observed estrus at the end of each protocol. Pregnancy was diagnosed via ultrasound at day 30 post-AI and confirmed by transrectal

palpation at day 45. Estrus response rates (74%, 48.6%, 40%; $P > 0.05$) and average pregnancy rates (54.4%, 31.4%, 28.6%; $P < 0.005$) were recorded, corresponding to conception rates of 73.1%, 65%, and 71.4% ($P > 0.005$) for groups 1, 2, and 3, respectively. Being simple, cost-effective, and efficient, the prostaglandin-only protocol is recommended for cows inseminated based on observed estrus. Protocols combining GnRH with PGF2α allow estrus synchronization, reducing the need for daily estrus detection and additional handling.

Keywords: Dairy cow, Estrus Induction, PGF2α , OvSynch, Select Synch

1. Introduction

In Algeria, the bovine herd constitutes only 6% of the nation's total livestock population, with the cattle numbers consistently remaining below 2 million heads for several years [1]. In this context, optimizing reproductive efficiency is crucial for enhancing the productivity of dairy operations. Holstein cattle, renowned for their high milk yield, dominate the dairy industry; however, their production levels are significantly influenced by various factors, particularly those related to management practices. One major challenge is the often low estrus detection rate, which in some cases falls below 50% [2].

To address these issues, hormonal protocols have been developed to improve estrus synchronization and reproductive performance. Prostaglandins, especially PGF2α, have been extensively investigated due to their strong luteolytic action, which is fundamental for initiating a new estrous cycle [3, 4]. Recent studies have shown that precise manipulation of follicular and luteal dynamics not only enhances reproductive efficiency but also increases the overall profitability of dairy farms when implemented in close collaboration with farmers [5]. Moreover, the addition of gonadotropin-releasing hormone (GnRH) to prostaglandin-based

protocols has emerged as a promising strategy. GnRH facilitates the regulation of follicular growth, thereby enabling the initiation of treatment at any stage of the estrous cycle and potentially overcoming the limitations imposed by low estrus detection rates [6].

Despite the proven success of these protocols in North and South America, their adoption in Africa remains limited [7]. Against this backdrop, the objective of the present study is to compare the efficacy of estrus induction protocols based on prostaglandins alone versus those combining prostaglandins with GnRH in dairy cows. In doing so, the study aims to provide insights into optimizing reproductive management practices on Algerian dairy farms, ultimately contributing to improved productivity and economic gains for local producers.

2. Material and methods

2.1. Study Location and animals

This study was conducted in two large dairy cattle farms located in the Setif region (Algeria) at an altitude of 1,080 meters, with geographical coordinates of 36°11'N latitude and 5°24'E longitude.

A total of 105 cyclic females, confirmed by transrectal palpation, aged between 2 and 5 years, including 66 Montbeliarde and 39 Holstein cows, were included in this study. The selected cows were free from anatomical or reproductive disorders and had a body condition score (BCS) of 2 to 3, according to the Campanile et al. [8] scale, at the time of reproduction, which occurred between 55 and 90 days postpartum.

The calculated reproductive performance parameters were determined as follows:

- **Estrus induction rate (EI):** Percentage of females observed in estrus relative to the total number of females subjected to reproduction in each group.

- **Conception rate (CR):** Percentage of pregnant females relative to the total number of inseminated females in each group.
- **Pregnancy rate (PR):** Percentage of diagnosed pregnant females relative to the total number of treated females in each group.

2.2. Experimental Protocols

The animals were randomly assigned to three groups of 35 cows each, receiving either prostaglandins alone (two injections) or prostaglandins combined with a single (GP) or double (GPG) dose of GnRH. The treatment protocols were as follows:

- **Protocol 1 (PGF2α alone):** Cows received two intramuscular injections of 25 mg Dinoprost at an interval of 11 to 14 days, depending on whether they were heifers or cows. Artificial insemination (AI) was performed based on observed estrus after the first PGF2α injection and between 72 and 96 hours after the second injection.
- **Protocol 2 (OvSynch variant):** Cows received an intramuscular injection of 100 µg Cystorelin (GnRH analogue) on day 0, followed by an intramuscular injection of 25 mg Dinoprost (PGF2α analogue) on day 7. A second dose of 100 µg Cystorelin was administered on day 9. Cows showing signs of estrus were inseminated 12 to 18 hours after the second GnRH injection.
- **Protocol 3 (Select Synch variant):** Each cow received an intramuscular injection of 100 µg Cystorelin on day 0, followed by an intramuscular injection of 25 mg Dinoprost on day 7. Cows observed in estrus were inseminated 8 to 12 hours after the end of the protocol.

2.3. Estrus Detection and Pregnancy Diagnosis

Estrus detection was based on visual observation, performed twice daily for at least 30 minutes. Cervical mucus permeability on the day of insemination was also used as a confirmatory sign of estrus. Cows were inseminated on heat observed with artificial insemination AI.

Pregnancy diagnosis was performed by echography at day 30 post-insemination, followed by transrectal palpation at day 45 to confirm pregnancy status.

2.4. Statistical Analysis

Data were analyzed using the SAS statistical software (version 9.12). The objective of the analysis was to assess the effect of the treatment on estrus response, pregnancy, and conception rates among the three treatment groups. Significant differences in reproductive performance among the tested cows were determined using the Chi-square test, with the significance level set at $p < 0.05$.

3. Results

The table 1 compares the effectiveness of three hormonal protocols (PGF2α, GPG, and GP) on estrus, conception, and gestation rates in 105 cows. The PGF2α protocol proves to be the most effective, with an estrus rate of **74.28%**, a conception rate of **73.1%**, and a gestation rate of **54.4%**, all significantly higher than the other groups ($p < 0.01$ or $p = 0.05$). In comparison, the GPG protocol shows intermediate results, with an estrus rate of **48.6%**, a conception rate of **70.58%**, and a lower gestation rate (**34.28%**). The GP protocol is the least effective, with respective rates of **40%**, **64.28%**, and **25.71%**, indicating reduced efficiency.

Overall, across the 105 cows studied, the estrus rate is **54.28%**, the conception rate reaches **70.17%** among cows in estrus, and the overall gestation rate is **38.09%**.

Statistical analysis highlights significant differences between the protocols, confirming the superiority of PGF2α in improving bovine reproduction.

In Protocol 1**,** 26 cows (74.28%) exhibited estrus between Day 1 and Day 18. Only **27%** of them showed estrus after the first PGF2α injection, whereas **73%** responded after the second injection.

For Protocol 2 (GPG)**,** 17 out of 35 cows (48.6%) were observed in estrus at the end of the protocol of which 8 cows (47%) showed estrus at Day 10 and 9 cows (53%) exhibited estrus two days later.

For Protocol 3 (GP)**,** 14 out of 35 cows (40%) displayed estrus at the end of the protocol, with 78.6% (11/14) of them showing signs between Day 9 and Day 12**.**

4. Discussion

The present results indicate that the $PGF_2\alpha$ protocol is superior in improving reproductive performance in cows, as evidenced by significantly higher estrus (74.28%), conception (73.1%), and gestation (54.4%) rates compared to the GPG and GP protocols.

In protocols based solely on prostaglandins, the synchronization rates of estrus vary from 38% to 97%, depending on the onset delay and dispersion of estrus [4]. The delay in the onset of estrus depends on the stage of the follicular wave at the time of the PGF2α injection, generally varying from two to five days in most cases and sometimes extending up to eight days [9]. Similarly, the dispersion of estrus after a single PGF2α injection makes systematic insemination more challenging. Grimard et al. [4] reported that only 60% of cycling cows were synchronized and inseminated based on observed estrus after the first prostaglandin injection. According to the same authors, 55% to 65% of treated females did not exhibit observable estrus after the first injection, which can generally be explained by discreet estrus

signs or treatment failure [4]. In our study, only 27% of cows exhibited estrus after the first injection, compared to 73% of females observed in estrus after the second PGF2α injection, resulting in an overall improved rate of 74%. Estrus rates of 30.8% to 32.8% after the first PGF2α injection have been reported in some studies [5, 10]. Meanwhile, Mialot et al. [3] reported a 70% estrus rate at the end of a protocol based solely on prostaglandins, a rate similar to that observed in our study. This clearly demonstrates that a single administration of PGF2α is not 100% effective in inducing luteolysis compared to protocols based on two injections of PGF2α, with the second injection always administered in the presence of a mature corpus luteum. In another study aiming to test the dose and route of administration of PGF2α, no significant difference in the efficiency of luteolysis was found [11]. However, the variability of the response appears to be greater with reduced doses.

Regarding gestation rates, Mialot et al. [3] reported rates close to 53.3% based on observed estrus compared to only 32.5% following blind inseminations after the second PGF2α injection [3], rates comparable to those found in our study. Protocols for estrus synchronization based on GnRH and PGF2α have been among the most studied treatments in recent years in dairy cows [5, 7, 12]. The addition of GnRH allows for a higher percentage of cows to present a dominant follicle at the start of the protocol, thus eliminating the need for observed estrus [6]. Nevertheless, low percentages of cows observed in estrus have been reported, probably due to the relatively lower estradiol concentration around the time of AI [3] and/or due to the influence of certain variability factors such as breed and parity [13].

The estrus induction rate observed in the “OvSynch” variant is comparable to that cited by Çevik et al. [2], although it is lower than that reported in other studies [12, 14]. With a few exceptions, some studies have reported low estrus response rates [15-17], even though the estrus observation periods were not significantly different. According to the literature, gestation rates reported in the “OvSynch” protocol ranged from 27% to 40% [18-20]. Pursley

et al. [6] reported gestation rates of 35.1% and 37.8% for heifers and cows, respectively. The gestation rate observed in the present study falls within the range reported in the literature, noting that ovarian and estrous responses to GnRH and PGF2α injections depend on the day of the estrous cycle at which the protocol is initiated [21, 22].

In the Select Synch protocol, the estrus response rate recorded is similar to that reported by Stevenson et al. [15], with the exception of some studies that reported higher gestation rates [23, 24]. According to Tenhagen et al. [25], this protocol is capable of synchronizing estrus in the majority of cows in a herd at low cost. In parallel, better conception rates were observed for all three groups treated in our study, with the highest rates consistently favoring the group based solely on prostaglandins.

According to the literature, estrus synchronization protocols based on "OvSynch" have resulted in conception rates in dairy cows and heifers ranging from 30% to 75% [12, 20, 24, 26]. The rates observed in the present study fall within the range reported by these authors, showing superiority compared to those reported in other studies [15, 23].

In conclusion, the comparison of the three hormonal protocols (PGF2α, GPG, and GP) highlights the significant superiority of the PGF2α protocol in inducing estrus, conception, and gestation. This protocol achieved the highest rates, with 74.28% of cows exhibiting estrus, a conception rate of 73.1%, and a gestation rate of 54.4%, demonstrating its effectiveness in improving bovine reproduction. In contrast, the GPG protocol showed intermediate results, while the GP protocol was the least effective, with the lowest estrus, conception, and gestation rates. Statistical analysis confirms significant differences between the protocols ($p < 0.01$ or $p = 0.05$), reinforcing the relevance of PGF2α in optimizing bovine reproductive performance. These findings emphasize the importance of selecting the appropriate hormonal protocol to enhance reproductive management in cattle farming.

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Authors' Contribution

Study concept and design: A.B. and A.N.

Conducting the experiment: A.B. and A.N.

Analysis and interpretation of data: N.O. and N.A.K.T.

Drafting of the manuscript: N.M., O.S. and N.A.K.T.

Critical revision of the manuscript: A.B., A.N., N.O. and N.A.K.T.

Ethical approval

Experimental procedures approved by the Institutional Committee for the Protection of Animals of the National Administration of Higher Education and Scientific Research of Algeria (98-11, Act of 22 August 1998).

Conflict of interests

The authors declare that they have no known conflict of interest in the conduction of the current study.

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Data Availability

Not applicable.

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