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Impact of Human Chorionic Gonadotropin and Prostaglandin $F_2\alpha$ Treatment on Progesterone Concentration, Oestrus and Pregnancy Rate in Friesian Cows

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Abstract

THE AIM of the research was for evaluation human chorionic gonadotropin (hCG) hormone to improve fertility on Friesian cows. A total of 39 cows postpartum ages ranged between 46–96 months, weighing 440 – 560 kg are used. Cows were divided into three groups (13 cows in each). The first group was injected hCG at 0 day of oestrous, followed by 5 days with 3 ml $PGF_2\alpha 6$, followed 1 days 3 ml $PGF_2\alpha$ followed by 2 day injected hCG and timed artificial insemination (TAI). The second group (G2) was injected hCG at 0 day, followed by 5days with 3 ml $PGF_2\alpha$, followed 1 days 3 ml $PGF_2\alpha$ followed by 2 day hCG, followed by 16-20h later with TAI. The thread group (G3) was injected hCG at 0 day, followed by 5 days $PGF_2\alpha$, followed 1 days 3 ml $PGF_2\alpha$ followed by 2 day hCG followed by 16-20h later with TAI, followed by 5 days injected hCG. The pregnancy rate was much greater in G3 (76.92%) and G2 (69.23%) than in G1 (53.85%). Concentration of progesterone (P4) in G1 or G2 was considerably (P<0.01) decreased in pregnant than in non-pregnant cows at AI, although it was increased in pregnant than in non-pregnant cows at 7, 14, and 24 days after AI. And, not all cows had a considerable P4 concentration before to treatment. Economic evaluation, the cost of hCG at insemination was the lowest (L.E 232/animal), while the cost of hCG following a 5-day TAI technique was the highest (L.E 290/animal).

Keywords: Friesian cows, hCG, $PGF_2\alpha$, progesterone and Pregnant rate.

Introduction

Progesterone used to induce and synchronise the occurrence of oestrus, while gonadotropins are used to induce follicular growth and ovulation. These interactions between the ovarian status and the hormonal treatments required to allow their application are largely responsible for the success of reproductive technologies [1, 2]. Competency of oocytes, growth of embryos, release of gonadotropin, growth of ovarian follicles, steroidogenesis, development of the corpus luteum, and reactions of the uterine endometrium are among the reproductive processes that are compromised [3].

For ruminants to undergo superovulation successfully, synchronization of follicle-wave emergence is a crucial technique because it enables artificial insemination at a set time without the requirement for oestrus detection. Combining the administration of progesterone (P4) and estradiol-17b (E2) is one of the more successful synchronization techniques. This results in the regression of the dominant follicle and the subsequent appearance of a new follicular wave [4].

Numerous researches have examined the association antral follicle numbers, the success of reproduction, and the efficiency of reproductive biotechniques in cattle [5]. Nevertheless, despite great progress, many aspects of the physiology of female reproduction are still unknown, particularly those concerning the distinctions between subspecies and the unique characteristics of the antral ovarian follicle population and its impact on the fertility of cattle [6,7, 8, 9]. While the number of antral follicles in the bovine ovary varies greatly [5, 10, 11, 12], the follicular count within the same individual is highly repeatable [5, 11].

Throughout the stages of sexual development (weaning to yearling ages) and in female receiving treatment for TAI that involves ovulation

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synchronisation [13], a pharmacological approach that enables the insemination of numerous animals without the requirement for oestrus detection, the same antral follicle count repeatability was noted in indicus-taurus animals [14, 7].

Similar to luteinizing hormone (LH), the hormone hCG has the ability to boost progesterone synthesis, cause ovulation throughout the oestrus cycle, and extend the longevity of the corpus luteum [15, 16]. The development of preovulatory follicles during luteolysis and the drop in progesterone concentrations affect when oestrus and ovulation occur. Reduced variation in follicle maturity during luteolysis and more consistency in the appearance of oestrus can be achieved by the use of an oestrus synchronisation system that maintains the status of preovulatory follicles [17]. According to research conducted by Balumbi *et al* [17], oestrus began 47.55 to 53.28 hours following prostaglandin F2α (PGF2α) injection. According to Sánchez et al [18], on days 7 (+22.2%) and 14 (+25.7%), the administration of hCG increased circulating P4 concentrations when compared to the control therapy.

The hCG is used to enhance CL development and raise the level of progesterone in the bloodstream. It primarily has an LH-like action and, to a very limited extent, an FSH-like effect [19]. Early pregnancy hCG administration promotes the development of an auxiliary CL in addition to the dominant ovarian follicle's ovulation. As a result, plasma progesterone levels rise and hCG can even cause follicles with a diameter of less than 10 mm to become receptive; it has a longer half-life than GnRH [21, 22, 23]. Plasma progesterone levels in cows given hCG on day 5 following oestrus grow until day 13 [22, 23] and this, in turn, promotes embryo survival later. The main causes of the repeat-breeding phenomena are follicular dynamics and the pituitary-ovarian axis [24]. Repeat breeders had lower progesterone concentrations than regular breeders within the six days following oestrus [25]. To address this annoying issue in dairy farms, prostaglandin F2α (PGF2α) and GnRH have been used in various combinations to boost the reproductive efficiency in nursing dairy cows [26].

Thus, the current study's goal was to evaluate more effective human chorionic gonadotropin hormonal regimens to enhance breastfeeding Friesian cows' ability to reproduce.

Materials and Methods

The Department of Animal Production, Faculty of Agriculture, Kafrelsheikh University, collaborated with the present research, which was conducted at the Sakha Animal Production Research Station, Animal Production Research Institute, and Agricultural Research Center. Permission to conduct this study was approved by Kafrelsheikh University's Animal Care and Ethics Committee in Egypt (license number: KFS1345/10).

Animals

In all, 39 Friesian cows were employed in this investigation. Cows weighed between 480 and 550 kg at 42 to 98 months of age. The Animal Production Research Institute's [27] systems were followed for feeding the animals, which included concentrate feed mixture, fresh Berseem, maize silage and rice straw Cows were kept loose in sheds that were partially open, and fresh water was provided at all times.

Treatment protocols

Friesian cows had divided into three groups (13 cows in each).

The first group (G1, n=13) was injected intramuscularly (i.m) by 3000 IU hCG, at 0 day of oestrous, followed by i.m. injection with 3 ml $PGF_2α$ analogue (Synchromate, Bremer Pharma 27540 Bremerhaven, Germany) at day 5 containing 0.750 µg cloprostenol, followed 1 days later by injection with a second dose of 3 ml $PGF_2α$ analogue followed by 2 day injected i.m 3000 IU hCG at the same time of AI by using frozen-thawing semen (Diagram 1 protocol 5-d Cosynch-72).

The second group (G2, n=13) received injections intramuscularly (i.m.) of 3000 IU hCG on the 0 day of oestrous, and then injections i.m. of 3 ml PGF2α analogue at day 5 containing 0.750 µg cloprostenol. One day later, an additional dose of 3 ml PGF2α analogue was administered, and two days later, the injection of 3000 IU hCG intramuscularly. Then, after 16-20 hours, artificial insemination was performed using frozen-thawing semen (Diagram 2, protocol 5-d Cosynch-88).

The thread group (G3, n=13) was injected i.m with 3000 IU hCG at 0 day of oestrous, followed by i.m. injection with 3 ml $PGF_2α$ analogue 0.750 µg cloprostenol, followed 1 days later by injection with a second dose of 3 ml $PGF_2α$ analogue followed by 2 day injected i.m with 3000 IU hCG followed by timed artificial insemination using frozen-thawing with 16-20 h later followed by 5 days injected i.m with 3000 IU hCG (3 days post artificial insemination) (Diagram 3, protocol 5-d Cosynch-5-d post AI).

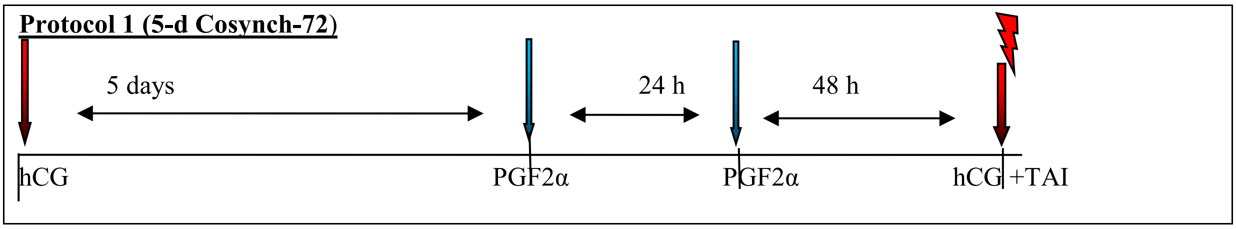

Diagram 1 Protocol 5-d Cosynch-72.

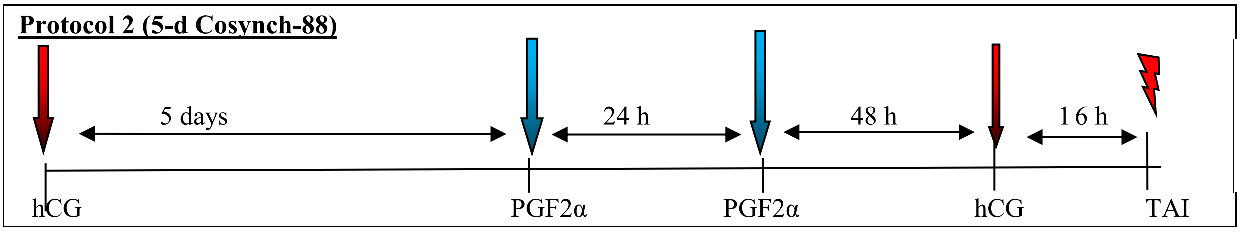

Diagram 2, protocol 5-d Cosynch-88

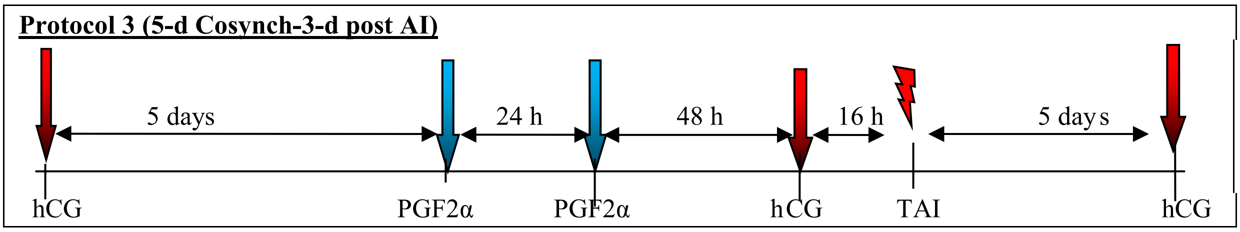

Diagram 3, protocol 5-d Cosynch-5-d post AI

Experimental procedures

Pregnancy diagnosis, treatment, and oestrous detection

Between 8 a.m. and 7 p.m., three times a day, oestrus was visually identified. Additionally, each treatment group employed a paint-supplied teaser bull to find the cows in estrus during the night, from 7 p.m. to 7 a.m.

The P4 concentrations on day 24 post-mating and rectal palpation on day 60 post-mating were used to confirm the pregnancy diagnosis.

Blood sampling

To measure progesterone, cows' jugular vein was used to extract blood samples. According to the scheduled protocol for each treated group, blood samples were taken three to four days prior to treatment in all treatment groups and after treatment. In all groups, samples had taken on the day of oestrus and following each dosage of therapy. Following that, blood samples had taken on days 7, 14, and 24 after the match. Blood samples had separated into serum by centrifugation for 15 minutes at 3000 rpm and then kept at -20 $^{\circ}C$ until the P4 assay.

Progesterone assay

The P4 concentration in blood serum was measured by direct radioimmunoassay (RIA) using a pre-made antibody-coated tube kit (Diagnosis Systems Laboratories, Texas, USA), in accordance with the manufacturer's instructions.

The progesterone antibody's cross-reaction (at 50% binding), according to the manufacturer, was 100% with progesterone, whereas it was less than 0.1% with any of the other steroids and 2.50, 6.00, 1.20, 0.80, 0.10 and 0.48% with 20-dione 11-Deoxycorticosterone, 5α-pregnone-3, 17α-Hydroxyprogesterone, 20-dione 11-Deoxycortisol, and 20α-Dihydroxyprogesterone, and 5β-pregnone-3, respectively.

The P4's standard curve was between 0.0 and 60.0 ng/ml. According to reports, the sensitivity value was 0.12 ng/ml. 8.0% and 13.1%, respectively, were the intra- and inter-assay coefficients of variance.

Statistical Analysis:

Data on P4 concentration had statistically analyzed in accordance with Snedecor and Cocharn [28] in order to compare conceived and non-conceived cows within each treatment group. The statistical model used was:

$$Y_{ik} = U + A_i + e_{ik}$$

Where:

Y_{ik} = Observed values

U = Overall means

A_i = Protocol

e_{ik} = Random error

The differences in conception rates between treatment regimens were tested using chi-square. The mean separations between treatment procedures for the total cost per animal were obtained using the Duncan Multiple Range test [29].

Results and Discussion

Oestrus and pregnant rates

Oestrus and pregnancy rates were affecting by different four hormonal treatments had shown in Table (1). Results cleared that all animals treatments with 5-d Cosynch-88 (G2) or 5-d Cosynch-5-d post AI (G3) exhibited oestrus, 84.61 and 92.31%, respectively, while the cows injected with 5-d Cosynch-72 gave the lowest value (69.23%).

In addition, pregnancy rate was appositive results of oestrus percentage. In the current study, pregnancy rate was higher significantly in G3 and G2 (76.92 and 69.23%, respectively) than in G1 (53.85%) with significant differences ($P \leq 0.05$) between three groups. These results are in agreement with the findings of Ideta *et al.* [30], Pregnancy rates are increased when hCG is administered to sustain luteal tissue following AI [31]. On the other hand, some research revealed no variation in the rates of pregnancy [32, 33], even though the administration of hCG during the early luteal phase was associated with a significant rise in serum progesterone concentrations [34]. Zheng *et al*. [35], hCG injection five days after AI improved luteal tissue function and their receptivity but did not increase pregnancy rates. Paksoy and Kalkan [36] found that the administration of hCG was unsuccessful when GnRH was given at ovulation in addition to hCG in the later part of the luteal phase (day 12). Conversely, Zolini *et al*. [37] observed that the increased pregnancy rate was associated with the genotype of individual cows when they administered hCG therapy five days after insemination. The effects of hCG given on day 5 following AI led to induces CL number improves, plasma P4 concentrations, and conception rate in high-producing dairy cows [23]. The researcher also observed pregnancy rates were higher for hCG treated cows on day 28, 45 and 90 after AI [38].

According to our findings, both treatments significantly increase the likelihood of conception in healthy animals [38].

This increase in conception could be attributed to synchronizing ovulation with insemination or timing ovulation, as well as increased progesterone secretion by CL because of an augmented LH surge brought on by GnRH or hCG therapy [39].

As, early luteal phase hCG administration results in the ovulation of the first-wave dominant follicle, the formation of a functional accessory corpora lutea, an increase in the surface area and volume of the CL, and a possible rise in the diameter of the CL. Additionally, it promotes the growth of luteal cells and increases plasma P4 concentrations. In addition to the stimulation of the spontaneous CL, the primary cause of this increase was secretion by accessory CL [19]. It was also shown that the development of accessory CL was mostly responsible for the rise in progesterone production following hCG injection. In light of this, it is feasible that hCG induction of an accessory CL on day five of the oestrous cycle will raise plasma P4 and improve embryo survival, both of which would increase pregnancy rates in dairy cows. The GnRH and hCG both have similar effects on the ovary, despite the fact that hCG has a longer half-life than natural LH and operates independently of the pituitary gland.

Moreover, three-wave follicular waves in which the appearance of the third-wave dominant follicle is delayed are more common in response to hCG treatment [20]. Because more cows with three follicular waves after insemination conceived than cows with two follicular waves, such a shift in follicular dynamics may increase the rate of conception [40].

Progesterone concentration

Table 2 displays the P4 concentrations in the blood serum of pregnant and non-pregnant cows treated with various hormonal treatments.

The current study demonstrated that the P4 concentration in pregnant lactating cows treated with hCG (G1) on the day of artificial insemination was significantly ($P<0.01$) lower than in non-pregnant cows at artificial insemination (oestrus); however, it was higher in pregnant cows in treatment groups after 7, 14, and 24 days of artificial insemination than in non-pregnant lactating cows. However, not all animals' pre-treatment P4 concentrations were statistically significant (Table 2).

Pregnancy has confirmed in cows of experimental treatment groups at day 24 post-insemination and P4 concentrations in pregnant and non-pregnant cows in G1 and G2 were 12.145 and 12.587 versus 3.268 and 2.574ng/ml, respectively.

Human chorionic gonadotrophin (hCG) in cattle displays activity similar to luteinizing hormone (LH) but with a longer half-life, which is consistent with the current findings. hCG administration has been shown to: (1) expand corpus luteum [41], (2) induce ovulation during the oestrous cycle [23], (3) promote the emergence of accessory CL [22], and (4) alter follicular wave dynamics. The CL produces increased endogenous P4 in response to hCG administration [21, 42].

Early embryonic mortality or unsuccessful embryo implantation may be connecting to the substantial decrease in P4 concentration observed in non-return/non-conceived cows after treatment. Regarding this, Moore et al. [43] found that between days 24 and 28, there was a correlation between decreased serum P4 concentrations and embryo loss.

The current data on the hCG protocol at insemination showed improvement conception rate. This may point to the primary cause of the incidence of repeat breeder cases, which is mistrusting the interval between the onset of oestrus, ovulation, and insemination.

P4 concentration pre-treatment tended to be similar in pregnant and non-pregnant cows, according to Table (2)'s data on the P4 profile prior to, during, and after (G3) timed AI. However, in both pregnant and non-pregnant cows, the first hCG injections barely raised P4 levels. Usually, hCG is given on day five after oestrus in order to align with the dominant follicle of the first wave. This causes ovulation and the development of an accessory CL, which raises the levels of P4 in the bloodstream [23, 44]. Administering hCG can cause the original CL to enlarge in addition to creating an auxiliary CL [45].

Following the injection of PGF2α, both pregnant and non-pregnant cows saw a significant decrease in P4, followed by a regression in CL function. Table 2 shows that the non-pregnant cows' values were somewhat lower than the pregnant cows'.

In every group, the progesterone concentration at the second hCG injection was considerably lower in pregnant cows than in non-pregnant cows.

In comparison to animals, post-2nd hCG injections may cause the dominant follicle to develop and ovulate within 24 hours, resulting in an average 24-hour increase in P4 concentrations [39].

In this study, the results cleared that the P4 concentration at oestrus was lower significantly in pregnant 0.325, 0.245 and 0.275ng/ml than in non-pregnant in 1.547, 2.447 and 3.214ng/ml, in G1, G2 and G3, respectively (Table 2).

Overall, a good period for oestrus occurrence and, by extension, a suitable time for insemination and fertilization may be responsible for the high pregnancy rate found in this study.

Generally, P4 profile on day 5, 10, and 24 post-mating generally indicated the presence of pregnancy in cows, being significantly ($P<0.001$) greater in pregnant than in non-pregnant cows in all protocols (G1, G2, and G3). During the luteal phase, the pregnant animals' serum P4 concentrations ranged from 9 to 11.5ng/ml, which was similar to the luteal concentrations reported by Foster et al. [46] between days 11 and 18 of the oestrous cycle.

The results similar with Rizwan *et al*. [47] found that at day 14 after artificial inseminations, the P4 concentration was significantly highest in pregnant cows of treated with hCG compared with non-pregnant cows of this group.

Pregnancy rates have been shown to rise when hCG is administered to sustain luteal tissue following AI [30, 31]. However, several studies Walton *et al*., [32]; Niles *et al*., [33] showed no difference in the rates of pregnancy despite a significant increase in serum progesterone concentrations following hCG injection during the early luteal phase [34]. According to Zheng *et al*. [35], luteal tissue function and receptivity were improved by hCG injection five days after AI, but there was no discernible increase in pregnancy rates. In a study where GnRH was administered at ovulation in addition to hCG in the latter stages of the luteal phase (day 12), Paksoy and Kalkan [36] reported that the injection of hCG was ineffective.

Conversely, Zolini et al. [37] and Karsavuranoğlu et al. [38] stated that administered hCG therapy five days following insemination and discovered a correlation between the rise in pregnancy rate and the genotype of individual cows.

Comparison among protocols

From the reproductive point of view, 28 out of 39 treated Friesian cows (71.79%) were pregnant using all hormonal protocols, being the highest in G3 (hCG after 5 days insemination protocols (76.92%), moderate (69.23%) in hCG at before insemination and the lowest (53.85%) in hCG at insemination protocol. Also, the economic evaluation indicated that hCG before or at insemination protocols had the cheapest cost (L.E 232/animal), while hCG after 5 days insemination protocols showed the highest cost (L.E 290/animal, Table 3). This means that total cost per treated groups were 2320, 2320 and 2900 LE/group in G1, G2 and G3, respectively (Table, 3). We can indicate that the cheapest cost was0e0 recorded in the G1 and G2, while the highest cost was in G3. Total cost of pregnant/protocol was lower in G3 (290 L.E per cow pregnant per protocol), moderate in G2 (331.4 L.E per cow pregnant per protocol), while the highest cost was in G1 (386.6 L.E per cow pregnant per protocol).

Conclusion

According to the current study, Friesian cows had a higher conception rate when there were variations in the average P4 concentration during the oestrous cycle and across protocols. The reproductive performance of Friesian cows improved when they were treated with hCG following AI methods compared to other protocols, the hCG after timed AI 5 days procedure yielded the best results in terms of pregnancy rate and modest costs from an economic perspective.

Author`s contributions

All authors contributed to the study's conception, and design. Data collection, examination and experimental study were performed by OAE, SHS, WAH and MAA. All biochemical analysis and data analysis were performed by MAA, IME and OAE. AMM, AAB, OAE and IME drafted and corrected the manuscript; MAA and IME revised the manuscript. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability Statement

All relevant data are available within the manuscript.

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Ethical statement

The Ethics Committee of Animal Production Research Institute, Agricultural Research Center approved all procedures involving animal subjects under protocol number ARC092017. The study adhered to the institutional and national guidelines, ensuring all efforts were made to minimize suffering and distress.

Conflict of interest

We declared that no conflict of interest.

TABLE 1. Evaluation of several hormonal therapies for reproduction

Item	Hormonal protocol		
	G1(1)	**G2(2)**	**G3(3)**
Treated animals (n)	13	13	13
Estrus exhibited (n)	9	11	12
Estrus rate (%)	69.23	84.61	92.31
Pregnant animals (n)	7	9	10
Pregnancy rate (%)	**53.85^{b}**	**69.23^{ab}**	**76.92^{a}**

(1): 5-d Cosynch-72, (2): 5-d Cosynch-88 and (3) 5-d Cosynch-5-d post AI protocols. a, b, and c: Significant differences are present between means in the same row with distinct superscripts (P<0.05).

TABLE 2. Progesterone levels (ng/ml±SEM) of the pregnant and non- pregnant animals in the treatment groups

Time	Items	Treatments		
		G1(1)	**G2(2)**	**G3(3)**
Pre-treatments	Pregnant	4.882±0.6	3.241±03	4.325±0.3
	Non-pregnant	3.742±0.5	2.954±0.4	2.135±0.2
During treatments:-				
Day -8	Pregnant	4.568±0.5	5.268±0.5	4.568±0.6
	Non-pregnant	3.254±0.5	3.257±0.6	3.584±0.4
Day -3	Pregnant	3.254±0.6	3.257±0.5	3.257±0.7
	Non-pregnant	2.354±0.4	3.258±0.4	2.984±0.3
Day -2	Pregnant	2.587±0.3	2.810±0.5	2.487±0.5
	Non-pregnant	3.568±0.4	3.608±0.3	3.328±0.4
At oestrus	Pregnant	0.325±0.1^{b}	0.254±0.2^{b}	0.276±0.1^{b}
	Non-pregnant	1.547±0.2^{a}	2.447±0.3^{a}	3.214±0.3^{a}
Post-treatments (insemination):-				
Day 7	Pregnant	10.245±0.7^{a}	11.254±0.8^{a}	10.257±0.4^{a}
	Non-pregnant	3.245±0.5^{b}	3.241±0.6^{bc}	2.987±0.6^{b}
Day 14	Pregnant	11.257±0.6^{a}	11.687±0.5^{a}	12.587±0.2^{a}
	Non-pregnant	3.568±0.4^{b}	4.235±0.8^{b}	3.245±0.3^{b}
Day 24	Pregnant	12.145±0.6^{a}	12.587±0.4^{a}	12.984±0.6^{a}
	Non-pregnant	3.268±0.5^{b}	2.574±0.6^{c}	3.268±0.5^{b}

(1): 5-d Cosynch-72, (2): 5-d Cosynch-88 and (3) 5-d Cosynch-5-d post AI protocols. a, b, and c: Significant differences are present between means in the same column with distinct superscripts (P<0.05).

TABLE 3. Reproductive evaluation and economic efficiency of different hormonal treatments

Time	Protocols		
	G1(1)	**G2(2)**	**G3(3)**
Reproductive evaluation of protocols			
Treated animals (n)	13	13	13
Conceived cows (n)	7	9	10
Non conceived (n)	5	4	2
Conception rate (%)	**53.85^{b}**	**69.23^{ab}**	**76.92^{a}**
Economic efficiency of protocols			
Treatment period (day)	8	8	11
Price of 1st injection (L.E)	60	60	60
Price of 2nd injection (L.E)	56	56	56
Price of 3rd injection (L.E)	56	56	56
Price of 4rd injection (L.E)	60	60	60
Price of 5rd injection (L.E)	-	-	60
Total cost of protocol (L.E/animal)	232±2.1^{b}	232±2.1^{b}	292±2.1^{a}
Total cost of protocol (L.E/group)	2320±22^{b}	2320±22^{b}	2920±22^{a}
Total cost of pregnant/protocol (L.E)	**386.6^{a}**	**331.4^{b}**	**290^{c}**

(1): 5-d Cosynch-72, (2): 5-d Cosynch-88 and (3) 5-d Cosynch-5-d post AI protocols. . Price of each injection from hCG and $PGF_2\alpha$ was L.E 60 and 56, respectively. a, b, and c: Significant differences are present between means in the same row with distinct superscripts (P<0.05).

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تأثير المعاملة بهرموني hCG و GF2α على تركيز البروجسترون والشبق ومعدل الحمل في أبقار الفريزيان

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الملخص

تهدف هذه الداسة هو تقييم هرمون hCG لتحسين الخصوبة في أبقار الفريزيان. تم استخدام إجمالي 39 بقرة بعد الولادة تتراوح أعمارها بين 46 – 96 شهرًا، ووزنها 440 – 560 كجم. تم تقسيم الأبقار إلى ثلاث مجموعات (13 أبقار في كل مجموعة). تم حقن المجموعة الأولى بـ hCG عند 0 يوم من الشبق، تليها 5 أيام مع 3 مل PGF2α6، تليها يوم واحد 3 مل PGF2α متبوعة بحقن hCG لمدة يومين والتلقيح الاصطناعي الموقوت (TAI). تم حقن المجموعة الثانية (G2) بـ hCG عند 0 يوم، تليها 5 أيام مع 3 مل PGF2α، تليها يوم واحد 3 مل PGF2α تليها 2 يوم hCG، تليها 16-20 ساعة لاحقًا مع TAI. تم حقن مجموعة الخيوط (G3) بـ hCG عند 0 يوم، تليها 5 أيام PGF2α، تليها يوم واحد 3 مل PGF2α تليها 2 يوم hCG تليها 16-20 ساعة لاحقًا مع TAI، تليها 5 أيام محقونة بـ hCG. كان معدل الحمل أكبر بكثير في المجموعة الثالثة (76.92%) والمجموعة الثانية (69.23%) منه في المجموعة الأولى (53.85%). انخفض تركيز البروجسترون (P4) في G1 أو G2 بشكل كبير (P>0.01) في الأبقار الحوامل عنه في الأبقار غير الحامل في AI، على الرغم من أنه زاد في الأبقار الحوامل عنه في الأبقار غير الحامل عند 7 و 14 و 24 يومًا بعد ذلك. منظمة العفو الدولية. وعلاوة على ذلك، لم يكن لدى جميع الفئران تركيز كبير من P4 قبل العلاج. بالتقييم الاقتصادي، كانت تكلفة hCG عند التلقيح هي الأقل (232 جنيهًا للحيوان)، بينما كانت تكلفة hCG بعد تقنية TAI لمدة 5 أيام هي الأعلى (290 جنيهًا للحيوان).

الكلمات الدالة: أبقار الفريزيان، hCG، PGF2α ، البروحستيرون ومعدل الحمل.