

Comparison of estrus synchronization with application of prostaglandin F2 α intrauterine and intramuscular in bali and cross-ongole cattle

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RESEARCH ARTICLE

Comparison of Estrus Synchronization with Application of Prostaglandin F_{2α} Intrauterine and Intramuscular in Bali and Crossbred-Ongole Cattle

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18 **ABSTRACT**

The object²⁵ of this study was to compare effects of intramuscular and intrauterine injection of prostaglandin F_{2α} (PGF_{2α}) on estrous synchronization in Bali and crossbred-Ongole cattle. A total of 80 Bali and 70 crossbred-Ongole (PO) cows were used for the study. The average body weights were 327±9.98 and 355±8.45 kg and were aged 4-8 years (parities 2 to 5) for Bali and PO cattle, respectively. The Bali and PO cows were divided into two treatment groups and to each cow, two injections of PGF_{2α}, 14 days apart were administered. Cows in group 1 (Bali, n=40; PO, n=35) were injected with 25 mg Dinoprost[®] (Glandins, Tad Pharmazeutisches werk GmbH, West Germany) intramuscularly (i.m). Whereas, for the cows in group 2 (Bali, n=40; PO, n=35), 5 mg Dinoprost[®] was injected intra uterine (i.u) using a modified AI gu⁵. The percentage estrus after first and second injection with i.m and i.u were non significantly differ⁵ (P>0.05) between Bali and PO cows. The percentage estrus response was significantly different (P<0.05) between first injection and²⁹ second injection. The pregnancy rate after first injection with i.m and i.u were non significantly different (P>0.05). Whereas, pregn¹²y rate after second injection with i.m and iu between Bali and PO cows were significantly¹² erent (P<0.05). Thus, differences in breed and method of PGF_{2α} administration were not significantly different (P>0.05). It was concluded that injection of PGF_{2α} via the i.u route resulted in similar estrus response and pregnancy rates compared with the i.m route of administration. Furthermore, the i.u application of the PGF_{2α} or its analogues may reduce the dose requirement of the drug.

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INTRODUCTION

There are two breeds of beef cattle in Indonesia namely Bali cattle and the crossbred-Ongole cattle called Peranakan Ongole (PO). The Bali cattle (*Bos sondaicus*), domesticated from *Bos banteng* in Java, have been reported to have higher reproduct³ performance than other indigenous Indonesian cattle. Bali cattle account for approximately 25% of the tota² cattle population in Indonesia (Lisson *et al.*, 2010). The population of Bali cattle is declining in most areas of eastern Indonesia because the demand for beef cattle exceeds the local capacity to supply these animals. The PO cattle are found in east and central Java, Indonesia. They were the outcome of cross-breeding between the Sumba-Ongole and Java-Ongole cattle breeds. The white coat color is dominant and they are also considered as a local breed in Indonesia (Martoyo, 2004).

To raise the reproductive efficiency of l¹⁶ cattle breeds, estrus synchronization has become a regular procedure to improve the useful reproductive life of livestock (Ruiz-Gonzalez *et al.*, 2012). Estrus synchronization and artificial insemination can also be used to optimize the reproductive potential of cows to get better pregnancy rate in the²¹ dern beef industry (Iqbal *et al.*, 2003). Furthermore, synchronization of estrus in cows facilitates the use of the fixed time artificial insemination (Kasimanickam *et al.*, 2009).

Several methods¹⁷ be used for estrus synchronization in cattle (de Araujo *et al.*, 2002; Neglia *et al.*, 200²⁴ including the use of Prostaglandin F_{2α} (PGF_{2α}) (Holm *et al.*, 2008). The use of prostaglandin F_{2α} or its analogues as a luteo⁴ in to block estrus and ovulation temporarily has been the most common method of estrus synchronization (Jainudeen *et al.*, 2000). The time taken for treatment with PGF_{2α} to induced estrus is inconsistent,

but generally varies from 2 to 5 days in heifers (Wenzel, 1997). PGF₂α or its analogues can cause regression of the corpus luteum (CL) in cows from day 5-6 until day 15-17 of the estrus cycle and can be used to synchronize estrus from day 7 onwards (Holm *et al.*, 2008). Nevertheless, the effectiveness of PGF₂α to synchronize estrus is dependent upon the presence of a responsive corpus luteum. The variation in time to estrus is due to the differences in the developmental stage of the pre-ovulatory follicle at the time of prostaglandin F₂α injection (Kastelic and Ginther, 1991; Macmillan *et al.*, 2003) and is not related to the rate of progesterone decrease to basal concentrations (Cirit *et al.*, 2008).

There are several different strategies to use PGF₂α for estrus synchronization in cows, the strategy used in this study is called the 2-shot prostaglandin protocol. There are numerous reports about using reduced doses of PGF₂α into various locations of the reproductive tract such as intravenous and intrauterine administration (Neglia *et al.*, 2008; Malik *et al.*, 2009). The PGF₂α can be administered through intramuscular injection or injected directly into the uterine musculature. It is hypothesized that intrauterine injection of PGF₂α and analogs for estrus synchronization would improve pregnancy rates. Therefore, the present study was designed to compare the effects of intrauterine and intramuscular injections of PGF₂α on estrus synchronization pregnancy rate in Bali and PO cattle.

MATERIALS AND METHODS

Animals: A total of 80 Bali and 70 PO cows were used for the present study. The average body weights were 327±9.98 and 355±8.45 kg, and aged 4-8 years (parities 2 to 5) for Bali and PO cattle, respectively. All the cows were 60-90 days postpartum and were calving normally. Their body condition scores were 5-6 on a scale of 1 to 9 (1=emaciated, 9=obese; Roche *et al.*, 2009). This body condition score was subjectively given to females to describe overall body condition, fat cover and flesh over the ribs, loin and tail head. Non-pregnant status in these cows was confirmed based on farm records and rectal palpation. The ovary was also palpated for the presence of either follicles or an active corpus luteum. All the cows were raised under a similar grazing system (various kinds of grass) and supplemented with mixture of rice bran (byproduct of milling) at the rate of 1.5 kg/head/day.

Experimental design: The Bali and PO cattle were divided into two treatment groups for estrus synchronization. The first group was injected with intramuscular and second group was injected with intrauterine. Cows in group 1 (n=40 Bali; n=35 PO) were each given injections PGF₂α intramuscularly (i.m) with 25 mg Dinoprost® (Glandins, Tad Pharmazeutisches werk GmbH, West Germany). Those in group 2 (n=40 Bali; n=35 PO) were injected with 5 mg Dinoprost® via intrauterine (i.u) by using a modified AI gun. The second injections of prostaglandin F₂α was given at 14 days after the first injection with same of method.

Estrus observation: The cows were observed continuously in the paddocks for estrus onset and behavioral patterns of

the estrus every 11 hours for 80 hours. All the cows were visually observed and standing to be mounted by another cow (homosexual mounting) was taken as an indication of estrus (Mattoni and Ouedraogo, 2000). Cows receptive to at least 2-3 mounts were considered to be in estrus. The percentage of estrus response was calculated by:

$$\text{Percentage of estrus} = \frac{\text{Number of cows in estrus}}{\text{Total number of cows synchronized}} \times 100$$

Artificial insemination and pregnancy diagnosis: All cows were artificially inseminated twice by an experienced technician using frozen Bali and PO semen obtained from the Artificial Insemination Centre (Singosari, Malang, Indonesia) at 72 hours after first injection (Cavalieri *et al.*, 2008). Cows that failed to exhibit estrus were given a second equal dose of prostaglandin F₂α after 14 days and underwent timed AI after 70-75 hours. Pregnancy diagnosis was conducted by rectal palpation 60 days after AI.

Statistical analysis: The proportions of cows that showed estrus after first and second PGF₂α injections, as well as pregnancy rates were analyzed by separate Chi-square analyses and Frequency Procedure of SAS software version 9.1.3 (SAS, 2006).

RESULTS

The percentage estrus response in Bali and PO cows in groups 1 and 2 following the first i.m and i.u injections were 41% (i.m), 38% (i.u) and 45% (i.m), 43% (i.u), respectively (Fig. 1). The percentage estrus response after first and second injection were non significantly different (P>0.05) between Bali and PO cows. The estrus responses after the second PGF₂α i.m and i.u injection were 80 & 84% and 83 & 78% in the Bali and PO cows, respectively. Thus, differences in breed and method of PGF₂α administration were not significant (P>0.05). The percentage estrus response was significantly different (P<0.05) between first injection and second injection. The pregnancy rates among the cows that were inseminated after the first injection were non significantly different (P>0.05) irrespective of the method of PGF₂α administration (i.m or i.u). Whereas, the pregnancy rates among the cows that were inseminated after the second injection were significantly different (P<0.05) between Bali and PO cows (Table 1). Pregnancy rates after first injection in Bali and PO cows were 55% (i.m), 50% (i.u) and 46% (i.m), 53% (i.u), respectively. Thus, route of administration did not result in significant differences between Bali and PO breed. Similarly, the pregnancy rate after the second PGF₂α injection was non-significantly different (P<0.05) between the i.m and i.u routes of PGF₂α administration.

DISCUSSION

The percentage estrus response among Bali and PO cows after the first PGF₂α i.m or i.u treatment was low compared with the second injection (Fig. 1). The percentage estrus response after the first injection is similar to 46.4% reported by Mattoni and Ouedraogo

(2000) for Indo Brazil and Gyrs cows that were estrus synchronized with PGF_{2α}. This lower percentage estrus response was probably because the cows that were used in the experiment were in different phases of the estrus cycle at the time of first injection. It is known that the success of estrus induction with PGF_{2α} depends on the presence of a functional corpus luteum. Smith *et al.* (2005) also reported that Prostaglandin F_{2α} was effective only in the presence of a responsive corpus luteum (luteal phase). The percentage estrus response among the cows after first injection i.u. was similar compared with the i.m. route. These results are in agreement with Ginther *et al.* (2009), who found that intrauterine PGF_{2α} injection in Holstein cows required lower amount of prostaglandin to induce luteolysis. The intramuscular injection of PGF_{2α} requires a higher dosage because this hormone will first be absorbed into the circulation before reaching its target organ, which is the ovary. On the other hand, intrauterine PGF_{2α} administration requires a lower dose, because the uterus is close to the target organ. Furthermore, the intrauterine route was effective in inducing increased CL blood flow, regardless of whether the treatment induced luteolysis (Malik *et al.*, 2009).

The higher percentage estrus response among cows after the second PGF_{2α} injection in both the i.m. and i.u. routes suggests that most of the cows were in the same luteal phase of the estrus cycle. PGF_{2α} or its analogues can be used to synchronize the cows estrus cycle from day 7 onwards (Holm *et al.*, 2008).

The pregnancy rates among Bali and PO cows after the first i.m. and i.u. administration were similar. Whereas, the pregnancy rates after the second i.m. and i.u. administration in Bali cows were higher than PO cows. The lower pregnancy rates after first injection in both cow breeds might be partially explained by the variation in time of ovulation with respect to time of AI. Much of the variation in time to ovulation was probably due to the variation in stage of growth of the preovulatory follicle at the time of PGF_{2α} treatment (Olivera-Muzante *et al.*, 2011). The pregnancy rate after the second PGF_{2α} injection in Bali cows (77.41%; i.m. and 73.33%; i.u.) was higher than the pregnancy rate in PO cows (54.54%; i.m. and 60%; i.u.). The pregnancy rate following the second PGF_{2α} administration in Bali cows was better than the 70.5% reported by Xu *et al.* (1997) in dairy cows. Williamson and Payne (1993) reported that Bali cattle have high adaptive capabilities to the tropical environment and have higher reproductive performance than other indigenous Indonesian cows. Intrauterine prostaglandins application may reduce the dose requirement of the drug. Furthermore, several authors have indicated that PGF_{2α} may be transferred directly from the uterine vein into the ovarian artery (Smith *et al.* 2005; McCracken *et al.*, 1999).

Conclusion: Based on the data obtained in these experiments, it may be concluded that estrus synchronization with PGF_{2α} injection using the intrauterine route resulted in similar estrus response and pregnancy rates to those with intramuscular administration. However, the pregnancy rate in Bali cows was higher than in the PO cows after the second PGF_{2α} administration.

Table 1: Comparison of pregnancy rate after estrus synchronization in Bali and PO cows

Breeds	Application	n	Dosage of PGF _{2α} (mg)	Pregnancy rate (%)	
				First injection	Second injection
Bali Cows	i.m.	40	25	(5/9) 55	(24/31) 77.41 ^a
	i.u.	40	5	(5/10) 50	(22/30) 73.33 ^a
PO Cows	i.m.	35	25	(6/13) 46	(12/22) 54.54 ^b
	i.u.	35	5	(8/15) 53	(12/20) 60.00 ^b

^{a,b} values in the same column with different superscripts indicate significant difference (P<0.05).

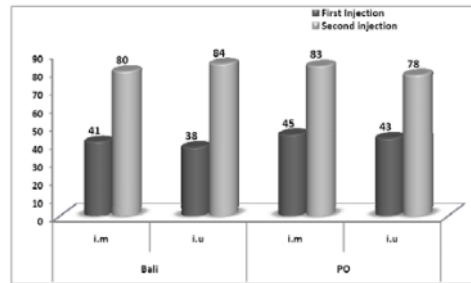


Fig. 1: Percentage response of estrus after estrus synchronization in Bali and PO cattle

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REFERENCES

- Cavaliere J, VM Smart, G Hepworth, M Ryan and KL Macmillan, 2008. Ovarian follicular development and hormone concentrations in inseminated dairy cows with resynchronized estrus cycles. *Theriogenology*, 70: 946-955.
- Cirit U, S Bacinoglu, M Tas, K Demir, A Bas, K Ak and IK Ileri, 2008. Evaluation of short estrus synchronization methods in dairy cows. *Anim Reprod Sci*, 109: 65-76.
- de Araujo Berber RC, EH Madureira and PS Baruselli, 2002. Comparison of two Ovsynch protocols (GnRH versus LH) for fixed timed insemination in buffalo (*Bubalus bubalis*). *Theriogenology*, 57: 1421-1430.
- Ginther OJ, RR Aroujo, MP Palhau, BL Rodrigues and MA Beg, 2009. Necessity of sequential pulses of Prostaglandin F₂ alpha for complete physiologic luteolysis in cattle. *Biol Reprod*, 80: 641-648.
- Holm DE, PN Thompson and PC Irons, 2008. The economic effects of an estrus synchronization protocol using prostaglandin in beef heifers. *Theriogenology*, 70: 1507-1515.
- Iqbal S, M Aleem and MA Saeed, 2003. Role of single injection of prostaglandin F₂ alpha on breeding efficiency of postpartum buffaloes. *Pak Vet J*, 23: 197-201.
- Jainudeen MR, H Wahid and ESE Hafez, 2000. Ovulation Induction, Embryo Production and Transfer. In: *Reproduction in Farm Animals*. 7 Ed, Lippincott, Williams and Wilkins, New York, USA, pp: 405-430.
- Kasimanickam R, ML Day, JS Rudolph, JB Hall and WD Whitzier, 2009. Two doses of prostaglandin improve pregnancy rates to timed-AI in a 5-day progesterone-based synchronization protocol in beef cows. *Theriogenology*, 71: 762-767.
- Kastelic JP and OJ Ginther, 1991. Factors affecting the origin of the ovulatory follicle in heifers with induced luteolysis. *Anim Reprod Sci*, 26: 13-24.
- Lisson S, N MacLeod, C McDonald, J Corfield, B Pengelly, L Wirajswadi, R Rahman, S Bahar, R Padjung, N Razak, K Puspadi, Dahlanuddin, Y Sutaryono, S Saenong, T Panjaitan, L Hadiawati, A Ash and L Brennan, 2010. A participatory, farming systems approach to improving Bali cattle production in the smallholder crop-livestock systems of Eastern Indonesia. *Agric Syst*, 103: 486-497.

- Macmillan KL, BVE Segwagwe and CS Pino, 2003. Associations between the manipulation of patterns of follicular development and fertility in cattle. *Anim Reprod Sci*, 78: 327-344.
- Malik A, A Gunawan, A. Wahid, Y Rosnina and M Afdal, 2009. Effect of prostaglandin $F_{2\alpha}$ intrauterine injection on estrus synchronization in Bali cattle. In: *Proc Int Conf Rumin Physiol (ICRP)*, Clenmort, France, pp: 630-633.
- Martoyo H, 2004. Indigenous Bali cattle: The best suited cattle breed for sustainable small farms in Indonesia, Lab. Animal Breeding and Genetics, Faculty of Animal Science, Bogor Agricultural University, Bogor, Indonesia, pp: 21-30.
- Mattoni M and A Ouedraogo, 2000. A comparative study on the oestrous response to PGF_{2a} analogue treatment and conception rates according to time of artificial insemination in Zebu (*Bos indicus*) and Baoule (*Bos taurus*) cattle. *Trop Anim Health Prod*, 32: 127-134.
- McCracken JA, EE Custer and JC Lamsa, 1999. Luteolysis: a neuroendocrine-mediated event. *Physiol Rev*, 79: 263-324.
- Neglia G, B Gasparini, R Di Palo, C De Rosa, L Zicarelli and G Campanile, 2003. Comparison of pregnancy rates with two oestrus synchronization protocols in Italian Mediterranean buffalo cows. *Theriogenology*, 60: 125-133.
- Neglia G, A Natale, G Esposito, F Salzillo, L Adinolfi, G Campanile, M Francillo and L Zicarelli, 2008. Effect of prostaglandin $F_{2\alpha}$ at the time of AI on progesterone levels and pregnancy rate in synchronized Italian Mediterranean buffaloes. *Theriogenology*, 69: 953-960.
- Olivera-Muzante J, S Fierro, V López and J Gil, 2011. Comparison of prostaglandin- and progesterone-based protocols for timed artificial insemination in sheep. *Theriogenology*, 75: 1232-1238.
- Roche JR, NC Friggens, JK Kay, MW Fisher, KJ Stafford and DP Berry, 2009. Body condition score and its association with dairy cow productivity, health and welfare. *J Dairy Sci*, 92: 5769-5801.
- Ruiz-González I, MA Sánchez, P García-Palencia, B Sánchez, RA García-Fernández, A González-Bulnes and JM Flores, 2012. Differences in uterine immunoexpression of PR, ER α and OTR when comparing prostaglandin- to progestagen-based protocols for ovine estrus synchronization. *Anim Reprod Sci*, 133: 93-100.
- Smith MF, GA Perry, JA Atkins, DC Busch and DJ Oaterson, 2005. Physiological principles underlying synchronization of estrus. In *Proc. Applied Reproductive Strategies in Beef Cattle*. Texas, USA, pp: 1-24.
- Wenzel JGW, 1997. Estrous Cycle Synchronization. In: *Current Therapy in Large Animal Theriogenology*; Youngquist RS, (ed), WB Saunders, Nevada, USA, pp: 290-100.
- Williamson G and WJA Payne, 1993. *An Introduction to Animal Husbandry in the Tropics*. Third Ed, Longman Group Limited, London, UK, pp: 753-756
- Xu ZZ, LJ Burton and KL Macmillan, 1997. Reproductive performance of lactating dairy cows following estrus synchronization regimens with PGF_{2alpha} and progesterone. *Theriogenology*, 47: 687-701.

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