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The Effect of One Shot Prostaglandin on Estrus Synchronization of Local and Holstein Friesian Cattle in and around Wukro Kilte Awulaelo District, Northern Ethiopia

Girmay Gebrehiwot[1] Berihu Gebrekidan[1] Bahlibi Weldegebriall[2*]
1. College of Veterinary Medicine, Mekelle University, Mekelle , Ethiopia
2. Axum Agricultural Research Center, Aksum, Ethiopia
E-mail:blenbah@gmail.com P.O.Box 230

Abstract
The study was conducted in Wukro Kilte Awulaelo district in four selected sites with the objective of evaluating the effect of prostaglandin on oestrus synchronization of local cattle and Holstein Friesian cattle.The animals were selected from small holder farmers and unorganized farms of the Wukro Kilte Awulaelo District in four selected locations which were reported as non-cycling by the owner. The selected animal were apparently clinically healthy, aged 2 to 12 year with parity of 0 to 7 with the body condition score varying between 3 to 5. Oestrus rate of cows to $PGF2_{\alpha}$is 91.67% while, the oestrus rate of heifers was 93.02%. The average rate of pregnancy of the cows and heifers in the study sites was 31.94% and 32.56%, respectively. The differences in oestrus rate within cows of different parity were slight. But cows of different parity had showed varied differences in the rate of conception. A greater difference was observed in oestrus rate of the cows and heifers of different body conditions. In contrast, cattle with body condition score of 5 have the lowest rate of conception (17.4%) compared to others. The cows and heifers with the body condition of 3 and 4 results in conception rate of 25% and 36.9% respectively.The degree of success of conception of semen from different bulls, Bull 10231 was the highest (37.5%) followed by bull 10131 and 10249 (33.33%). The least degree of success of conception of semen was recorded for bull 11249(27.27). Analysis of the data on the basis of local and exotic breeds revealed that out of 76 local cows and heifers treated with one shot prostaglandin, 24 (31.57%) were became pregnant and from the 39 exotic cows and Heifers treated, 13 (33.33%) were resulted in conception.Slight difference had also been observed in the rate of pregnancy between heifers and cows.The overall mean oestrus rate was 92.17%, while, the overall mean rate of pregnancy of was 32.17%. From the findings of this study it can be inferred that prostaglandin was effective to synchronize cows and heifers. In contrast, the rate of pregnancy was very low. Therefore, selection of dairy belts, farmers and cattle for synchronization should be done carefully. Moreover, strategic feed supplementation of synchronized cattle should not be neglected. Those cows that show standing oestrus should only be inseminated.
Keywords: Conception rate;Synchronization; Oestrus; Bull

INTRODUCTION

Ethiopia has over 50 million indigenous cattle, and about 10 million are breeder cows, with annual calving rate of 45%. The number of improved dairy type animals is insignificant. Average milk production from local cows is 1.54 liters/cow/day (CSA, 2009/10) with total annual production of 2.94 billion liters. Per capita milk consumption is low and stands at 19 kg/year. Due to the high demand-supply variance, annual import of dairy products is over USD 10 million. The current human population of 80 million will double by 2030; increasing the demand for dairy products. However, there is huge potential for dairy development due to the large human and livestock population and suitable agro-ecologies. One of the major problems hindering smallholder farmers from participating in milk production and marketing is lack of access to and high price of improved dairy animals. Hormonal oestrus synchronization under smallholder context could be used, among others, to produce large number and dairy animals in a short period of time (kick start), to match calving with feed availability and market demand for dairy products and to improve the effectiveness and efficiency of AI service (FAO, 2011).

However, production efficiency of cattle is low in Ethiopia despite their large population. Although Ethiopia is sufficient enough in meat production, still imports many dairy products. Milk produced from the animals provides an important dietary source for the majority of rural and periurban population. However, the country's per capita milk consumption is estimated to be about 19.2kg per year, which is far below the average per capita consumption of Africa 37.2kg per year (FAO, 2000).

Fertility is an important factor for the production and profitability in dairy herds (Gokhan, 2010). A calving interval of 12 to 13 months is generally considered to be economically optimal, but often difficult to achieve. To meet this goal cows must cycle and become pregnant within an average of 85 days postpartum. Besides, the incorporation of efficient and accurate heat detection, proper semen handling and servicing techniques, and timely insemination relative to ovulation of the egg are also key factors. However, a long postpartum anoestrous period is a very common problem in cows reared in a tropical environment (Million,

2010).

Estrus (heat) detection has been cited as the most important factor affecting the reproductive success of artificial insemination programs. However, proper control of the time of estrus is difficult, since peak estrus activity often occurs at night, and determination of the actual onset of standing estrus may be difficult without 24 h observation (Aulakh, 2008).

To this effect, the benefits of using technological options and approaches to improve supply of desirable animal genetic material that incorporates estrus synchronization and AI can be tremendous. These systems allow producers to reach certain production or economic goals quicker than natural service and can open the doors to value added markets as well by shortening and concentrating the calving andbreeding season; inducing anestrous cows and pre-pubertal heifers to cycle; introducing new genetics into the herd; increasing calf performance and weaning weights with earlier birthdates; enabling more cows to be artificially inseminated to a genetically superior bull and decreasing the labor cost for heat detection (Bambal, 2011).

Historically, estrus synchronization has been promoted as a labor saving tool for those producers who want to capitalize on the superior genetics available through use of AI. However, the labor saving aspect is peanuts compared to the economic returns available when estrus synchronization is used as a "reproductive management tool". It's important to get dairy and beef producers speaking the same language. Beef producers typically breed cows during "breeding seasons" while dairy producers attempt to get cows pregnant shortly after a "voluntary waiting period." Breeding season and voluntary waiting period are different ways of saying the same thing. In each case, we want all animals to conceive within a reasonable amount of time after calving (45 to 90 days). This is essential to maintenance of a short (12 to 13 months) calving interval and is a primary factor affecting the profitability of any cattle breeding enterprise. In order to lend some unbiased consistency, we'll use the term "breeding period" to refer to that window of time within which you begin your attempts to achieve pregnancies in your cows. Because the estrous cycle is 21 days long, you (or the herd bull) can only expect to catch about 1/3 of the cycling animals in heat during the first week of the breeding period if you don't use estrus synchronization. Regardless of whether the animals are inseminated naturally or artificially, you can only expect 65 to 70% of them to conceive to a given insemination. Thus, after a week of breeding to natural heats, only 21% of the eligible animals could possibly be pregnant (33% in heat x 65% conception). Because many animals may not have resumed normal cycling activity, the actual pregnancy rate during the first week of the breeding period will likely be considerably less (Million *et al*., 2011).

Many estrus synchronization protocols can induce 75 to 90% of the cycling animals to display estrus within a 5 day period. Additionally, many protocols can induce a fertile heat in as much as 50% of the anestrous cows. Thus, it is typical for many of these synchronization protocols to result in 45 to 55% of the animals being pregnant by the end of the first week of the breeding period. Several fixed-time AI options can result in 40 to 50% of the cows pregnant following one single day of breeding with zero hours spent for heat detection. Cows that display estrus during the first week of the breeding period will have 3 opportunities to conceive during the first 45 days while those who don't will have 2 or less. Also, cows that do not respond to estrus synchronization may be problem animals. Early identification of problem cows allows appropriate veterinary therapy to be administered in a timely fashion and reduces the potential for excessive days open(Million *et al*., 2011).

These days, prostaglandin is used to synchronize oestrus in dairy cattle operations to boost the efficiency of AI by inducing the regression of the corpus luteum (Murugavel*et al*., 2010; Diaz *et al*., 2005). Prostaglandin is the first method of heat synchronization that depends on the presence of a functional CL particularly in the diestrus stage of the estrous cycle (day 7 to 17 of the cycle) (Cordova-Izquierdo*et al*., 2009). Its effectiveness usually affected by heat stress, asynchronous ovarian events exhibiting incomplete or delayed luteolysis, and weak or delayed estrous (Lamb, 2001 and Dejarnette, 2004).

Evaluating the reproductive ability of breeding stock is crucial for cow/calf operation. Cattle that have irregular estrus cycle often have difficulty becoming pregnant, thus increasing the total days open and reducing the total number of calves weaned per cow (Wilson and Gilson, 2005).

Estrus synchronization can minimize the amount of time and labor required to accurately detect estrus. Many reproductive hormones are used in estrous synchronization. Developing a basic understanding of several reproductive hormones is necessary when trying to determine which protocol will work best for your herd.Progesterone (P_4), prostaglandin ($PGF_{2\alpha}$), gonadotropin releasing hormone (GnRH), follicle stimulating hormone (FSH) and luteinizing hormone (LH) are a few of the hormones involved in the estrous cycle. Depending on the estrous synchronization protocol, these hormones can be used independently or in combination with one another (Timothy, 2003).Therefore to boost the dairy and meat industries, evaluation and demonstration of the effect of Prostaglandin on estrus synchronization under small holders' condition is indispensible.

General Objective

- To develop technological options and approaches that improves supply of desirable animal genetic material for dairy cattle.

Specific Objectives

- ✓ To evaluate the effect of prostaglandin on oestrus synchronization of postpartum local cattle.
- ✓ To assess the rate of conception using one shot prostaglandin in smallholder dairy farmers.

MATERIALS AND METHODS

Study Area

The study was conducted in Wukro Kilte Awulaelo District of the Eastern zone of Tigray Region. From the Wukro Kilte Awulaelo District four sites were selected, namely Aynalem, Adiksandid, Genfel and Wukro city. Wukro Kilte Awulaelo district is located in an altitude between $13^{0}47^{0}$North and $39^{0}36^{0}$East and elevation in 1977m.a.s.l. The mean annual temperature in the study area varies from 11.1^{0}C to 28.3^{0}C and is Weina Dega in agroecologic zone. Prior to prostaglandin injection appropriate animal handling facilities were installed in a centralized location and all logistical arrangements were spelled out.

Study Animals

A total of 115 dairy cows and heifers were selected from small holder farmers and unorganized farms of the Wukro Kilte Awulaelo District. The animals were reported to be non- cyclic by the owner. However, on transrectal palpation a majority of the females were diagnosed to be cycling (presence of well -developed CL in either ovary). The selected animal were apparently clinically healthy, aged 2 to 12 year with parity of 0 to 7 with the body condition score varying between 3 to 5 and feeding of straw, hay, concentrates, alfalfa were included in the feeding system.

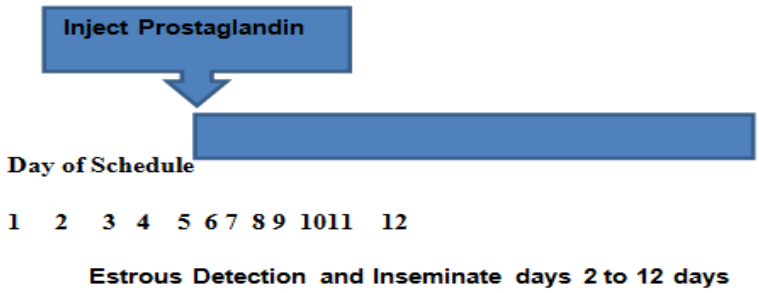
Data Collected

Age of the cow, body condition of the cow, parity, body weight, Corpus Luteum orientation, date and time of hormone treatment, date and time of oestrus detection, status of cervix, Bull No., Date and time of insemination and pregnancy ratewere recorded.

Treatment Protocol

Based on trans rectal palpation, the females which were diagnosed to be cycling (presence of well -developed CL in either ovary) were injected with Prostaglandin (Estrumate)of 2ml intramuscularly. Within 2 to12 days after the injection the females were followed for detection of estrus and all the cows and heifers in heat or silent heat was inseminated artificially. The materials used in this study were animal handling crash, Prostaglandin (Estrumate), Long sleeved gloves, Latex hand gloves, Needles (18" x 21), Syringes (5-10 ml); Sheath, Ear tag applicator, Ear tags and marker.

Figure1. One Shot Prostaglandin



Statistical Analysis

Data on breed, location, age, body condition score, bull number, parity, Artificial insemination, presence of corpus luteum, status of cervix and status of pregnancy were summarized by descriptive statistics using SPSS computer software program (Version 20).

RESULTS

A total of 115 local cattle Holstein Friesian cows and heifers with good body condition were injected 2 ml prostaglandin intra muscular (Gokhan *et al*., 2010). Within 2 to 5 days after injection, all the cows and heifers in heat or silent heat was inseminated artificially using 100% Holstein Friesian bull semen. The average weight of cows and heifers were 239 (130-340) kg and 235 (143-308) kg, respectively. Pregnancy diagnoses were undertaken 3 months later through rectal palpation and foetus size. Pregnancy diagnoses were undertaken 3 months later through ovarian palpation and foetus size smaller than the suggested size at three months were regarded as bull pregnant.The oestrus rate of cows to $PGF2_{\alpha}$is 91.67% while, the oestrus rate of heifers was 93.02%. The average rate of pregnancy of the cows and heifers in the study sites was 31.94% and 32.56%, respectively.A greater difference was observed in oestrus rate of the cows and heifers of different body conditions. In contrast, cattle with body condition score of 5 have the lowest rate of conception (17.4%) compared to others. The cows and heifers with the body condition of 3 and 4 results in conception rate of 25%

and 36.9% respectively.The degree of success of conception of semen from different bulls, Bull 10231 was the highest (37.5%) followed by bull 10131 and 10249 (33.33%). The least degree of success of conception of semen was recorded for bull 11249(27.27). Analysis of the data on the basis of local and exotic breeds revealed that out of 76 local cows and heifers treated with one shot prostaglandin, 24 (31.57%) were became pregnant and from the 39 exotic cows and Heifers treated, 13 (33.33%) were resulted in conception.The overall mean oestrus rate was 92.17%, while, the overall mean rate of pregnancy was 32.17%.

The Response of Prostaglandin and Rate of Pregnancy across Sites in the District

The highest rate of pregnancy was recorded in Genfel 4(57.14%) followed by Adikisandid 10(32.26%) and Wukro city8 (32%) leaving least rate of conception in Aynalem site 15 (28.85%) in the district.The oestrus rate of the cattle to $PGF_{2\alpha}$ found in this study was105(91.3%) and an overall pregnancy rate of 37(32.17%).

Table 1: Variations in Oestrus Rate to $PGF2_{\alpha}$and Pregnancy Rate across sites in the District

Sites	**Number of Observation**	**Number of cows/heifers responded to $PGF2_{\alpha}$**	**Rate of response to $PGF2_{\alpha}$**	**Number of cows/heifers Inseminated**	**Pregnancy rate**
Aynalem	52	46	88.46%	52	15(28.85%)
Genfel	7	7	100%	7	4(57.14%)
Adikisandid	31	28	90.32%	31	10(32.26%)
Wukro city	25	24	96%	25	8(32%)
Total	115	105	91.30%	115	37(32.17%)

Variations in Prostaglandin Response and Pregnancy Rate Due to Parity

Oestrus rate of cows to $PGF2_{\alpha}$is 91.67% while, the oestrus rate of heifers was 93.02%. The average rate of pregnancy of the cows and heifers in the study sites was 31.94% and 32.56%, respectively. The overall mean oestrus rate was 92.17%, while, the overall mean rate of pregnancy of was 32.17%. The differences in oestrus rate within cows of different parity were slight. The same was also true for the difference between cows and heifers. But cows of different parity had showed varied differences in the rate of conception. Slight difference had also been observed in the rate of pregnancy between heifers and cows.

Table 2: Oestrus Rate to $PGF2_{\alpha}$ and Pregnancy Rate of cows and heifers due to variation in Parity

Injected with $PGF2_{\alpha}$		**Cows/heifers responded to $PGF2_{\alpha}$**	**Rate of response to$PGF2_{\alpha}$**	**Number of cows/heifers Inseminated**	**Pregnancy rate**
Cows(Parity)	**Number of cows/heifers**				
1	21	19	90.5%	21	7(33.33%)
2	27	25	92.6%	27	13(48.15%)
3	19	17	89.7%	19	3(15.79%)
4	3	3	100%	3	0
5	1	1	100%	1	0
7	1	1	100%	1	0
Total	**72**	**66**	**91.67%**	**72**	**23(31.94%)**
Heifers	43	40	93.02%	43	14(32.56%)
Overall	**115**	**106**	**92.17%**	**115**	**37(32.17%)**

Variations in Prostaglandin Response and Pregnancy Rate Due to Difference in Body Condition

A greater difference was observed in oestrus rate of the cows and heifers of different body conditions. In contrast, cattle with body condition score of 5 have the lowest rate of conception (17.4%) compared to others. The cows and heifers with the body condition of 3 and 4 results in conception rate of 25% and 36.9% respectively. Consistent with the theoretical fact, the least rate of pregnancy was recorded for cattle with the least body condition score.

Table 3: Variation in Oestrus and Pregnancy Rate Due to variation in Body Condition

Injected with PGF2$_\alpha$		**Cows/heifers responded to PGF2$_\alpha$**	**Rate of response toPGF2$_\alpha$**	**Number of cows/heifers Inseminated**	**Pregnancy rate**
Body Condition Score	**Number of cows/heifers**				
3	8	7	(87.5%)	8	2(25%)
4	84	77	(91.67%)	84	31(36.9%)
5	23	21	(91.3%)	23	4(17.4%)
Total	**115**	**105**	**(91.3%)**	**115**	**37(32.17%)**

Variation Due to Semen Sources

In terms of degree of success of conception of semen from different bulls, Bull 10231 was the highest (37.5%) followed by bull 10131 and 10249 (33.33%). The least degree of success of conception of semen was recorded for bull 11249(27.27).

Table 4: Variation in Oestrus and Pregnancy Rate Due to Semen Sources

Bull No.	**Number of Observation**	**Conception**	**Degree of success (%)**
10189	30	9	30
10131	3	1	33.33
10231	40	15	37.5
11249	33	9	27.27
10249	9	3	33.33
Overall	115	37	32.17

Variation due to Breeds

Analysis of the data on the basis of local and exotic breeds revealed that out of 76 local cows and heifers treated with one shot prostaglandin, 24 (31.57%) were became pregnant and from the 39 exotic breeds cows and Heifers treated, 13 (33.33%) were resulted in conception.

Table 5: Variation in Oestrus and Pregnancy Rate in local and exotic cattle breeds

Breed	**Number of Observation**	**Conception**	**Degree of success (%)**
Local	76	24	31.57
Exotic	39	13	33.33
Total	115	37	32.17

3.6. Variation due to Age

In terms of the variation in age, there was a slight or no difference in the success of the conception, by which the cows score a conception success of 23(31.94%) and the heifers degree of success was (32.56%).

Table 6: Variation in Oestrus and Pregnancy Rate Due to variation in Age

Age	**Number of Observation**	**Conception**	**Degree of success (%)**
Cows	72	23	31.94
Heifers	43	14	32.56
Total	**115**	**37**	**32.17**

DISCUSSION

Infertility due to failure of estrus in heifers and post-partum cow is a serious problem leading to considerable economic loses to the dairy industry. Anoestrus in pubertal heifers leads to delayed onset of puberty, lowers the reproductive rate of young females and consequently high age at first service. Postpartum anoestrus delays rebreeding after parturition, resulting into long calving intervals(Britt *et al.,* 1986).The local cattle and Holstein Fresian cattle in Genfel showed the highest rate of response to prostaglandin followed by Adikisandid, Wukro city and Aynalem sites in the Wukro Kilte Awulaelo district. The oestrus rate of the cattle to $PGF_{2\alpha}$ found in this study(91.3%) is slightly lower than the result obtained in Adigrat- Mekelle Milkshed, Tigray (99.5%) and higher than what was reported in Hawassa-Dilla Milk shed, SNNPR (76.1%) in a similar mass synchronization campaign (IPMS, 2011) and (Million, 2010) (67.3%). But, it was extremely higher than the results forBrown Swiss (61.1%) and Holstein (50.8%) cows. The same was also true for Brown Swiss (54.6%) and Holstein Frisian in heifers (Diaz *et al*., 2005) with two injections of $PGF_{2\alpha}$ 11 days apart. It also agrees with the results of Murugavel and his colleagues (2010) who confirmed 70 to 90% oestrus rate within 2 to 5 days when $PGF_{2\alpha}$ was administered to cows with a functional corpus luteum.

The estrus response in the selected sites of the district in the present study was 91.3% which was lower than the previous report100% (Teklebrhan,2011-unpublished). In the previous study (Diriba,2010)reported a

100% estrus response which is higher than the present study. Gordon (1996) observed that an estrus response of 90%using any method available currently should be considered as successful. Accordingly the estrus response obtained in the present study result is very good. This is probably a reflection of the high degree of the efficacy of the treatment regime. Equally important is also the careful selection of the animals on the basis of body condition score and reproductive tract scores. Animals in poor body condition or with poorly developed ovaries and tubular genital tract are not fit for one shot prostaglandin synchronizing programs.

Evaluation of the body condition (Noakes*et al*., 2001) is an important tool to determine which animals are fit to receive the hormonal therapy. Apparently the fact that in the present investigation the animals with body condition score 3 responded favorably to estrus synchronization in agreement with the above reports.

The average rate of pregnancy (32.17%) recorded in this study is higher than the national rate of pregnancy (27%) reported by Desalegn*et al*., (2009) and much lower than the preliminary results of mass synchronization in SNNPR (63%) and Tigiray (62%) (IPMS, 2011). The rate of pregnancy was also less than the rate of pregnancy stated in the guideline, 50% of prostaglandin responsive cows and heifers should conceive and what was reported by million (2011) (47.5%). Such extreme discrepancy might be due to shortage of feed; heat stress, anoestrus cattle, body condition and exposure of synchronized cows for local bulls immediately after insemination as evidenced in the field visit.

The pregnancy rates obtained in the present study were almost similar with the cows. The lower pregnancy rates recorded in the present investigation can possibly be explained by the carelessness selection of the animals at the start of the experiment. However, since the number of animals in this study was not large in number, further studies on larger numbers are called to validate the present findings. Yet the overall pregnancy rate of 32.56%in heifers, 31.94% in cows and the combined pregnancy rate of 32.17%is not satisfactory.

In conclusion the results of the present investigation are highly disagrees with the result of the previous study conducted in the country. Although the cost of the treatment regime used inthis study may appear to be high, we are not totally convinced that it is highly economical in view of the losses that may accrue. A distinct possibility regarding the use of the system exists (Martinez *et al*.,2002) which could lower the cost of treatment.From the findings of this study it can be inferred that prostaglandin was effective to synchronize cows and heifers. In contrast, the rate of pregnancy was very low. Therefore, selection of dairy belts, farmers and cattle for synchronization should be done carefully. Moreover, strategic feed supplementation of synchronized cattle should not be neglected. Those cows that show standing oestrus should only be inseminated.

CONCLUSION AND RECOMMENDATIONS

From the findings of this study it can be inferred that prostaglandin was effective to synchronize postpartum local cows and heifers. In contrast, the rate of pregnancy was very low. Therefore, selection of dairy belts, farmers and cattle for synchronization should be done carefully. Moreover, strategic feed supplementation of synchronized cattle should not be neglected. Those cows that show standing oestrus should only be inseminated.

Failure to detect cows and heifers in estrus is a very important factor which contributes significantly towards delayed age at first calving in heifers and long calving intervals in adult cow. Estrus induction/ synchronization will give an opportunity to schedule the calving time with feed availability and the animal can produce more calves in her life time by reducing the calving interval .Moreover, through estrus synchronization technology , it is possible to schedule the milk yield availability with the consumption demand. As a result of increasing information and the development of new techniques ,there are several ways in which it may be possible to enhance pregnancy rate in dairy and beef cattle.

Therefore, on the basis of this study the following recommendation are forwarded:-

- The excellent rate of estrus response in the present study confirms the results obtained previously by another study in the region.
- The low pregnancy rates obtained highlights the need for careful selection of the animal, at the start of the experiment.
- From the obtained results, so far, it appears that the technology is fit and ready for wide spread field trials.
- The various products used in study need to be made easily available in the local market.
- Further investigation which can potentially lower the cost of treatment are essential.

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