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Improving Dairy Production Through Biotechnology Assisted Crossbred Heifer Production in Tigray Ethiopia

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Abstract
The study was conducted in Adigrat-Mekelle milk shade (Ganta Afeshum and Kilteawlaelo Districts) with the objective of evaluating the effect of prostaglandin on Estrus synchronization of dairy cattle and to increase the availability of crossbred heifers through combined use of Artificial insemination service and Estrus synchronization techniques. Six potential peasant associations (three from each district) were selected to conduct biotechnology assisted reproductive management on dairy cow and heifers. Animal handling facilities were already established in almost all the selected areas. A technical team was established from researchers, veterinaries, and AI technicians. Higher officials of ILRI at Ethiopian Meat and Milk Development Institute (EMMDTI) provided training to the technical team for 15 days. About 230 dairy cows and heifers were presented for synchronization. Local cows (Arado), HF and their crossbred were screened using parity (2-5), body condition (2-4), and reproductive history (cyclic). Only 199 (87%) dairy cows and heifers were injected with 5 ml $PGF_{2\alpha}$ (Lutalyse hormone) intra muscular. Six (3%) cows aborted due to the hormone effect as they were at early pregnancy. About 193 (97%) of the total synchronized dairy cows and heifers were presented for final insemination. 15 (8%) of the inseminated dairy cows and heifers were lost for insemination and 178 (92%) were inseminated at fixed time of 48 and 72 hours after the hormone treatment. Fates of the final inseminated cows and heifers were abortion 5%, infection 8%, repeated 12%, died 1%, and sold 9%. Only 145(82 %) of the total inseminated cows and heifers were presented for final pregnancy diagnosis 3 months later through ovarian palpation. The response to the administration of $PGF_{2\alpha}$ was 100% with mean proportion of 61% pregnancy rate.
Keywords: Dairy cows, Synchronization, prostaglandin, Heat estrus and Pregnancy rate

Introduction

Dairy production is becoming one of the main economic ventures in urban, and peri urban and rural farming communities of Tigray. Dairy production contributes much in household income and improved nutrition, there by food security in the region. It in most cases is based on indigenous cattle types/breeds. The indigenous cows are poor in terms of milk production traits compared to the crossbred dairy cows. To improve productivity of indigenous breeds the Ethiopian Agricultural Research Institute and Regional Research Institutes have been collaboratively working on crossbreed dairy cow improvement and popularization for several years. In Tigray regional states, efforts have been doing for a years to improve productivity of the sector using AI technique. However, poor heat detection, unskilled AI technicians, and some logistic problems limited its development. Some reports indicate that the efficiency of insemination is low; the pregnancy rate at first service in Tigray is only 3%. So searching other technology that could solve the problem is mandatory. Prostaglandin is one of the economical feasible hormones used to synchronize Estrus in dairy cattle operation to boost the efficiency of AI by inducing the regression of the corpus luteum (Diaz *et al*., 2005). Prostaglandin regress the functional CL particularly in the diestrus stage of the estrous cycle (day 7 to 17 of the cycle) (Cordova-Izquierdo *et al*., 2009). There are considerations during evaluation of its effectiveness such as heat stress and the reproductive physiological stage of the animal (Dejarnette, 2004). The aim of the study was to investigate the efficacy of prostaglandin estrus synchronization based on the CL presence of followed by timed AI in dairy cows.

General objectives

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

Specific objectives

- Improving the effectiveness of the insemination (increasing pregnancy rate/first insemination) and the efficiency of the AI service delivery
- To evaluate the effect of prostaglandin on estrus synchronization of dairy cows and heifers
- To assess the perception of smallholder dairy producer farmers on mass synchronization of dairy cows and heifers

Materials and Methods

Area description

The study was conducted in Adigrat-Mekelle milk shade (Gantafshum and kilteawlalo distrcits). These two districts were purposively selected due to a large market potential, accessibility for transportation, good livestock population, and present and near feature market opportunity.

Approach for mass synchronization and insemination of dairy cows

A brief discussion was held with livestock experts, veterinarians, and AI technicians of the selected district to select potential peasant association and for logistic arrangement of the project. A technical team from researchers (3), veterinaries (2), and AI technicians (2) was established. Higher officials of ILRI at Ethiopia meat and milk development institute (EMMDTI) trained the technical team for a week (Fig. 1). After the training, the team handle the project and started the actual work, each steps of the technical team was followed up by the implementing organization and on the way the team gat a feedback from higher officials of the organization.

Figure 11. Technical team established for implementing mass estrus synchronization dairy cow in Tigray

Community mobilization for Cow/heifer selection

Awareness creation on Artificial Insemination of the dairy cows with induced sign of estrus using Prostaglandin hormone was done with community for making a sense of ownership of the project (Fig. 2). The participant farmers were selected based on the following Criteria: Households with at least two cows/heifers, who have adequate feed resource, with experience in managing dairy animals and milk marketing were selected.

Figure 12. Community mobilization for making a sense of ownership of the project

Cow selection and screening for mass synchronization

A total of 230 cows and heifers were presented during the screening stage. Body condition was scored based on Nicholson and Butterworth (1986) developed for zebu cattle body condition score. The candidate cows and heifers

were from Holstein Friesian, local and their crossbreds. Age was estimation from the owner and using erupted permanent pair of incisors. 1st , 2nd , 3rd and 4th pairs of permanent incisors equivalent to an age groups of 27-32, 32-36, 40-44 and 47-54 months, respectively. Each of the presented cow and heifer were screened using Body Condition Score (BSC 1-9), parity and reproductive histories (Cyclic). Cyclic cow/heifer with BCS ≥2 and second and above parity were selected for mass synchronization. About 30 cows and heifers were rejected during the screening stage due to poor body condition (Fig. 3) and reproductive and health problems. About 200 cows and heifers were checked for the presence functional CL and Diagnosed for detecting early-established pregnancy. Finally, about 199 cows and heifers with active CL were presented for hormone treatment and identified with ear tag.

Figure 13. Local cow with poor Body condition (Score 1) rejected during screening

Synchronization protocol

The protocol for estrous synchronization was one injection of PGF2α (Lutalize) after the CL has been diagnosed using the rectal palpation method. A single dose of 5 ml PGF2α intramuscular injection in the hipbone muscle was given to cows and heifers not in heat within the last 5 days before hormone treatment using 10 ml syringe and 10 g needle PGF2α. (Fig 4). The day of PGF2α treatment was considered as day 0.

Figure 14. Prostaglandin Hormone dose preparation for dairy cow mass synchronization

AI service semen type

Mass insemination was done two times within 48 and 72 hours after hormone treatment (Fig 5). During insemination HF bull semen and jersey was used in different blood level of exotic breed. In this regard, we had been given 100% HF for local breed. In addition, we had been used 100% jersey for small size local cows and in a place, which was far from town to make them beneficiary from butter production than milk.

Figure 15. Mass Insemination of Prostaglandin treated cows and heifers

The systematic practice of artificial insemination after estrus synchronization is a technique that overcomes the problems associated with heat detection (Vounparet *et al*., (2013).

Data collection and analysis

Age of the cow, body condition of the cow, parity, body weight, Corpuslutuem orientation, date and time of hormone treatment, date, and time of Estrus detection, Bull No., Date and time of insemination, pregnancy rate were recorded. Data were analyzed using SPSS version 16.0 commuter software using simple descriptive analysis such as mean and percentage.

Figure 16. Data recording system during mass synchronization of the selected dairy cows

Materials used

Animal handling crash, Prostaglandin (Lutalyse); long sleeved gloves; Latex hand gloves, Needles (18" x 21); Syringes (5-10 ml); Sheath; Ear tag applicator; Ear tags and marker were the materials used in this study.

Result and Discussion

The distribution of the total candidate cows and heifers was 103 and 96 cows and heifers from G/afeshum and K/awlalo district, respectively. Out of the 199 synchronized dairy cows and heifers, six cows (3%)were aborted due to the Luteolytic effect of $PGF_2\alpha$ treatment as they were in early pregnancy and the owners had no idea when they were bred (Fig. 7).

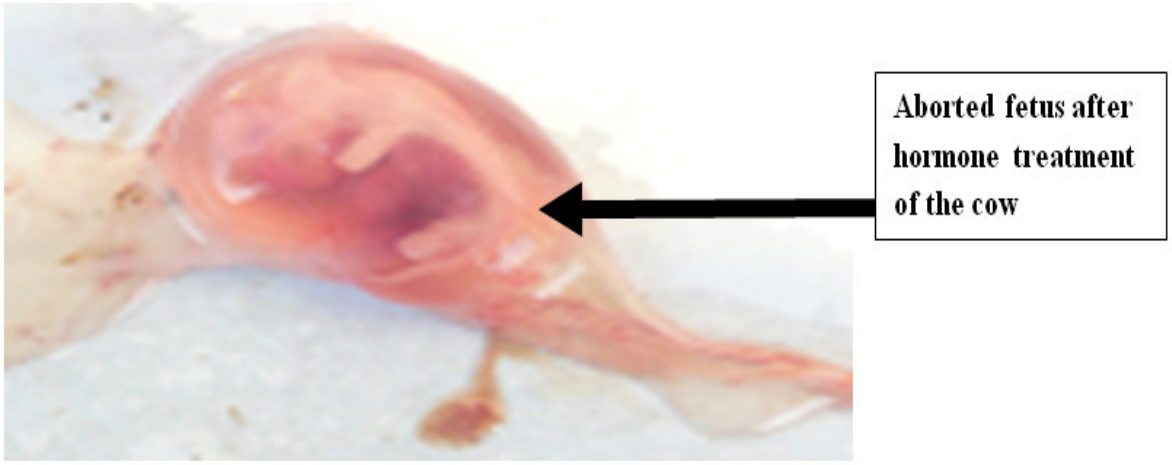

Figure 17. Effect of Prostaglandin on early-established pregnancy

The luteolytic effect of Prostaglandin on functional corpus luteum was able to synchronize estrus in dairy cows and heifers. The criteria retained for the evaluation of heats were restless, snaffling, vaginal mucus discharge (Fig. 8) and opening of the cervix observed using rectal palpation. The average time for estrus sign was 45.13 hours with pick heat sign ranges 48-72 hours after hormone treatment. The current study found that the response rate of the local and crossbred cow to one injection of PGF2α was 100%, which is in line to the finding of Tewodros *et al,* (2015) observed as 100% (98.9% and 100% in local and crossbred cows, respectively). Girmay *et al*., (2015) reported 91.67% rate of response for local and crossbred cows treated with PGF2α (Estrumate).

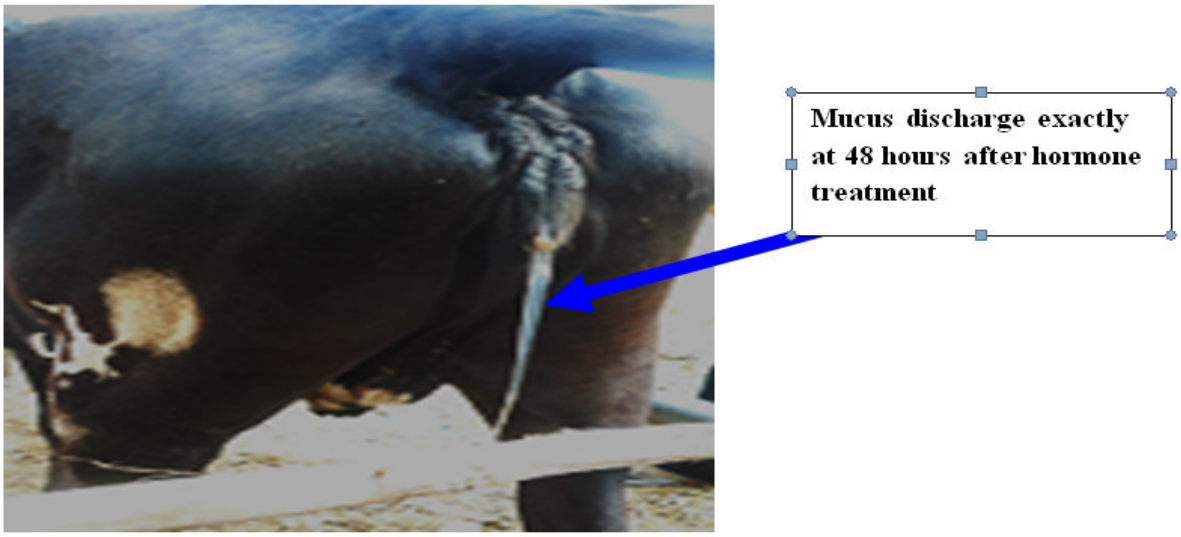

Figure 18. Sign of pick heat (Mucus discharge) observed on synchronized cow

Table 1 describes the process how to evaluate the performance of Estrus synchronization on dairy cows and heifers. A total of 178 cows and heifers (100 from Adigrat, 78 from Wukro) were inseminated using HF bull semen labeled for its viability and bull number (10-206) at different blood level of exotic breed. Rarely Jersey bull (100% blood level) was used for small framed cows and heifers and in a place, which is far from town to make them beneficiary from butter production than milk. The achievement of the mass synchronization was 95% (G/Afeshum) and 89% (K/Awlaelo) of the final synchronized cows and heifers (97%). Some of the synchronized animals inseminated (16) once when there was a clear sign of estrus at 48 hours after one injection of PGF2α treatment otherwise inseminated two times at 48 and 72 hours after treatment. Fates of the final inseminated cows and heifers were abortion 5%, infection 8%, repeated 12%, died 1%, and sold 9% (table 1). Only 145 of the 178 total inseminated cows and heifers were presented for PD check three months later on the hormone treatment. The overall pregnancy rate of the total presented animals were 61%, which was the overall all performance of the mass artificial insemination and synchronization of Adigrat- Mekelle milk shade. Desalegn (2009) reported that the rate of pregnancy of cows with artificial insemination in Tigray is only 27%. Biotechnology assisted Estrus synchronization in dairy cows enhanced the rate of pregnancy up to 61%. The study indicated that the comparative advantage of insemination of several cows at the same time in one location instead of the traditional approach of inseminating individual cows in different locations.

Table 15. Performance of estrus synchronized cows in two milk shades

Variables	Adigrat milk shade		Wukro milk shade		Overall	
	No	%	No	%	No	%
Total animal presented	125	-	105	-	230	-
Total animals synchronized	**103**	**82%**	**96**	**91%**	**199**	**87%**
Aborted after treatment	3	3%	3	3%	6	3%
Final total cows synchronized	**100**	**97%**	**93**	**97%**	**193**	**97%**
Inseminated	95	95%	83	89%	178	92%
Animals lost for insemination	5	5%	10	11%	15	8%
Repeated	6	6%	5	6%	11	6%
Sold after inseminated	7	7%	2	2%	9	5%
Infected (reproductive problem)	3	3%	4	5%	7	6%
Animals that died after conceived	1	1%	-	-	1	1%
Aborted after conceived	4	4%	1	1%	5	3%
Total inseminated animals for PD check	**71**	**75%**	**74**	**89%**	**145**	**82%**
Pregnant	**43**	**61%**	**45**	**61%**	**88**	**61%**

The achievement of the current study of attaining 61% of pregnancy rate is higher than the findings of Vounparet *et al*., (2013) reported as 29.41% and Girmay *et al*., (2015) reported as 32.25%. The finding of the current study is in line to the suggestion of Holm *et al.,* (2008) that stated attaining high rate of pregnancy at lowest cost is among the goal of any insemination program. The technological intervention linked to the institutional change is the hormonal synchronization of the heat cycle of the cows. Vounparet *et al*., (2013) found that the rate of synchronization of one injection of $PGF_2\alpha$ in cattle was 76.47%. Vounparet *et al*., (2013) concluded that fertility rates of the cattle remain mostly in Africa below the natural breeding cases (60% to 70%). The main reason for the different findings on pregnancy rate of treating with prostaglandin in different area might be the variation on the skill of AI technicians, environmental condition, facilities, materials used, type of hormone, and the selection of right animal at right time.

Perception of the smallholder farmers and scale up best practices

About 200 smallholder farmers were participated during the first phase evaluation of mass synchronization and insemination of the cows and heifers. They were very interested and eager in adopting the technology even at earlier of mass synchronization. Most of the participant farmers confirmed that injection of PGF2α hormone abled to synchronized Estrus in cows and they under stood it is better from the conventional breeding of their cows. Tigray Agricultural Research Institute (TARI) in collaboration of IPMS and the regional government of Tigray scaled up the successful mass insemination of cows across the region. Now a day, the conventional Artificial insemination of dairy cows is supported with Estrus synchronization using PGF2α hormone in almost all of the districts of the regional government of Tigray.

Conclusion and Recommendation

Conclusions

The findings of this study indicated that prostaglandin was effective to synchronize post-partum dairy cows and heifers. It is possible to scaling-up and out in other areas where there is potential for dairy development. Well-planned and organized technological intervention with appropriate organizational and institutional arrangements is important. Well trained and organized multi-disciplinary team (livestock science, feeds and nutrition experts, veterinarians, AI technicians, etc) and proper leadership, good planning, implementation, follow-up, awareness creation, proper training, careful selection of the right farmers and animals (good BCS, free from diseases and with functional ovaries). Community participation involving administration, office of agriculture, local leaders, lead farmers, particularly women farmers, Construction of proper animal handling facility at a convenient location, Adequate supply of inputs, consumables, equipment, transport, etc.

Recommendations

- To practice a successful heat synchronization attention has to take on synchronization protocol in relation to, semen quality, proper use of the hormone, capability of the AI technicians, animal selection and feed availability.
- Heat synchronization has the ability to create a dramatic change in AI service efficiency and local breed improvement in milk production so governmental and non-governmental or policy makers should give a great attention to the proper use of the technology through capacity building

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