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Study on the Conception Rate of Dairy Cows Artificially Inseminated During Natural Heat and By Synchronization in Fogera Woreda, North-West of Ethiopia

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Abstract: The study was conducted from September 2014 to August 2015 in Fogera Woreda of North-Western Ethiopia with the objectives of assessing the effectiveness of synchronization with $PGF_2\ \alpha$ and evaluating the efficiency of pregnancy of dairy cows artificially inseminated during natural heat (oestrus) and by synchronization. Out of the total 620 (497 local and 123 cross breed) heifers and cows inseminated artificially, 194 females were conceived (pregnant) with the overall pregnancy rate of 31.29%. A total of 527 females, by natural heat and 93 females, by synchronization (after a single injection of 2 ml $PGF_2\alpha$, IM) were inseminated. It was found out that the proportion of cows that successfully conceived significantly differed ($p< 0.05$) between the two methods. Higher rate of conception was observed in natural heat (32.07%) as compared to synchronization (26.88%). Similarly, higher rate of pregnancy were observed in cross breed cows (52%) than local breeds (48%). However, there was no any significant difference ($p> 0.05$) observed in the conception rate of the two breeds. Regarding to synchronization, 100% (17 out of 17) of crosses and 98.68% (75 out of 76) of local breed cows were responded to heat oestrus after a single injection of $PGF_2\ \alpha$ within 14 days. However, the difference was not statistically significant ($p> 0.05$) between breeds. Finally, it can be concluded that prostaglandin $F_2\alpha$ was effective to synchronize dairy cows although the rate of pregnancy was very low. Therefore, selection of dairy belts, farmers and cattle for synchronization should be crucial. In addition, strategic feed supplementation of synchronized cattle should be essential. Moreover, only those cows that showed standing estrus should be inseminated.

Key words: Synchronization · Natural Heat · Conception rate · Dairy cows · Fogera · Ethiopia

INTRODUCTION

Animal production has an important role to play as food of animal origin represents about one sixth of human food energy and one third of the human food protein on a global basis. In this ratio, milk and its products by playing a formidable role in human nutrition have made theriogenologiests to play a pivotal role in developing technologies to improve the reproductive efficiency in dairy cattle in turn to increase the efficiency and profitability of milk production [1].

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 [2] 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 estrus 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

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feed availability and market demand for dairy products and to improve the effectiveness and efficiency of AI service [3]. 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 peri-urban population. However, the country's per capita milk consumption is estimated to be about 19.2 kg per year, which is far below the average per capita consumption of Africa 37.2 kg per year [4].

Fertility is an important factor for the production and profitability in dairy herds [5]. 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 anestrous period is a very common problem in cows reared in a tropical environment [6].

The reproductive performance of high yielding cows with high genetic merit declines in many dairy industries. One of the major constrains of profitable dairy farming is low pregnancy rate in cows [7]. The productivity of cattle could be low because of poor nutrition and incorrect detection of estrus [8-10], prolonged postpartum anestrus, calving interval and interval to first service, ovarian disorder. High yielding dairy cows often suffer from one or another ovarian disorder. The situation is further aggravated during early postpartum period. In fact, regular cyclicity before 50 days postpartum is observed in only 51% of highly yielding dairy cows. Risk factors such as calving season, problem in calving, clinical disease, ketosis or severe negative energy balance during the postpartum period are related to delayed cyclicity before service [1].

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 [11]. 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 and breeding 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 [12].

Estrus synchronization can minimize the amount of time and labor required to accurately detect estrus. For this purpose, many reproductive hormones are used in estrous synchronization. Progesterone (P4), 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 [13].Therefore, to boost the dairy and meat industries, evaluation and demonstration of the effects of Prostaglandin F2α on estrus synchronization is crucial.

Even though dairy production plays a very significant role in the livelihood of farmers in the study area, dairy production system and productive and reproductive performance of dairy cows have not been studied. Thus, the objective of this study was to assess the efficiency of synchronization with single injection of prostaglandin F2 α and to compare the pregnancy rates of dairy cows artificially inseminated by natural heat (estrus) and by synchronization in Fogera Woreda, North-West of Ethiopia.

MATERIAL AND METHODS

Study Area: The study was conducted in FogeraWereda, which is one of the 106 Woreda's of Amhara Regional State and found in South Gondar Zone, Ethiopia. Wereta is the capital of the FograWoreda and is found 625 km from Addis Ababa and 55 km from Bahir Dar. The woreda is situated at 11° 57´N to 12°30´N latitude and 37°35´E to 37°58´E longitude. The altitude ranges from 1774 to 2410 masl. The mean annual rainfall of the woreda is 1284.2 mm and most of this rainfall occurs during ´kiremt´ season between June and September. Temperature ranges from 10°C to 27°C with mean value 18°C. Fogera is divided into 30 rural and 4 urban kebeles. The total land area of the Woreda is 117,405ha. Flat land accounts for 76% of the total land coverage while mountainous hills and valleys account for 11% and 3%, respectively. The livestock population in the woreda was estimated as 239,812 cattle, 35,512 sheep, 28,942 goats, 132,454 poultry, 22,579 bee hives, 21,126 donkeys, 6 horses and 399 mules in the Woreda [14].

Study Population: In this study, the breeding herd consisted of cows from different breeds and localities of Fogera Woreda. The study group consisted of 497 females of Fogera and Boran breed (local) and 123 females crossbred between Holstein Frisian and Fogera. During the study the following data were collected: conception (determined by rectal palpation 60 to 90 days following insemination), inseminator identity, cow identity, day of insemination, farming area, cattle breed, parity, body condition score using a scale ranging from 1 (emaciated) to 5 (obese) and cattle management systems. They were reared under intensive and semi-intensive management systems.Prostaglandin F_2 α was injected once to cycled females. After a single injection of PGF_2 α, all the cows were induced to heat. Prostaglandin F_2 αinjection takes place at any time of the cycle. The cows were inseminated by three inseminators (one service for each cow)with frozen semen (-196° C) of selected bulls (Holstein) imported from Israel. At day 60 post AI, pregnancy diagnosis was made by trans-rectal palpation.

Data Analysis: All necessary data for the study (breed) were collected and summarized by descriptive statistics using SPSS computer software program (Version 20).

RESULTS

Out of the total 620 (497 local and 123 cross breed) cows inseminated artificially, 194 cows were conceived (pregnant) with the overall pregnancy rate of 31.29% (Table 2). A total of 527 females, during natural estrus (heat) and 93 females, by synchronization (after injection of 2 ml PGF_2 α, IM) were inseminated (Table 2). After synchronization with PGF2α, 93 of 93 females came into heat at 14 days with efficiency rate of 100% (Table 1). The criteria retained for the evaluation of heats were coupling simulation, internal signs (vaginal mucus discharge and opening of the cervix) observed using a speculum.

A significant difference (p<0.05) was observed in the pregnancy rate of cows inseminated by natural heat and by synchronization. Higher rate of pregnancy were observed in those females inseminated from heat detection by natural estrus (32.07%) as compared to those by synchronization (26.88%) (Table 2). Similarly, 2 (1 local and 1 cross breed) animals lost their PGF2 α, IM injection in the early days of the operation and all (75 local and 17 cross breed) females were showed signs of heat (response) with treatment of PGF2 α hormone with response rates of 98.68% and 100% in local and cross breeds, respectively (Table 1).

A total of 194 calves were delivered. Of which, 86 were females while 108 were males (Table 3). Among these calves, 169 were obtained from those cows inseminated by natural heat and 25 were obtained from those cows inseminated by synchronization (Table 3).

Table 1: Response of Cows to Synchronization with single injection of PGF_2 α:

Breed	Total No of Cows	Responded to PGF2 α	Response rate to $PGF_2\alpha$
Local	76	75	98.68%
Cross	17	17	100%
Total	93	92	98.92%

Table 2: The Conception rate of dairy cows inseminated during natural heat and with synchronization:

		Breed			
AI with	Total No of Cows	Local	Cross	No of Pregnant Cows	Pregnancy rate (%)
Synchronization	93	76	17	25	26.88
Natural Heat	527	421	106	169	32.07
Total	620	497	123	194	31.29

Table 3: Calves obtained by insemination with natural heat and synchronization:

	Breed of Cow			Calves obtained		
AI With	Local	Cross	Total No of Cows	Female	Male	Total No of Calves
Synchronization	76	17	93	10	15	25
Natural Heat	421	106	527	71	98	169
Total	497	123	620	86	108	194

DISCUSSION

In this study, the signs of heat were observed in 98.68% (75 of 76) local and 100% (17 of 17) cross breed females treated with prostaglandin PGF 2α, with overall heat rate of 98.92%. The difference in the rates of heat between the two breeds was not statistically significant ($p > 0.05$). These findings coincide with those of Girmay *et al.* [15] (91.3%) in and around WukroKilteAwulaelo District, Teklebrhan [16] (100%) in Mekelle, Diriba [17] (100%) in and aroundMekelle, Cisse [18] 90% and 100% were recorded respectively in cycled prim-parous cows of N'Dama and Maure zebu breeds, Lhoste and Pierson [19] who was observed 76% to 100% heat rate after the contribution from the second year of the PMSG to the association of estradiol and Cronolone, Mbaye and Ndiaye [20] 92.8% in Senegal with the Gobra zebu following treatments with implants and Mbaye [21] 85.7% in Europe with Charolais and Salerstreated with prostaglandin. However, the current findings were higher than previous reports of IPMS [22] and Million [6] who reported 76.1% and 67.3% in Hawassa-Dilla Milk shed and in SNNPR with mass synchronization, respectively. But, it was extremely higher than the results for Brown Swiss (61.1%) and Holstein (50.8%) cows. The same was also true for Brown Swiss (54.6%) and Holstein Frisian in heifers [23] with two injections of PGF 2α 11 days apart. It also agrees with the results of Kailasam and his colleagues [1] who confirmed 70 to 90% estrus rate within 2 to 5 days when PGF 2α was administered to cows with a functional corpus luteum. Gordon [24] stated that any method that could achieve 90% estrus response in cows should be considered as effective and successful. Accordingly, the estrus response obtained in the present study was 98.92%, which was very promising and it could be successful. This was probably a reflection of the high degree of the efficacy of the treatment regime. Similarly, careful selection of the animals on the basis of body condition scores and reproductive tract scores might be contributed for the high rate of cows at heat. Animals in poor body condition or with poorly developed ovaries and tubular genital tract were not fit for prostaglandin synchronizing programs.

In the present study, out of the total 620 (497 local and 123 cross breed) female cattle inseminated artificially, 194 were found conceived with overall pregnancy rate of 31.29%. Among which, 36 (29.27%) were local while 158 (31.79%) were cross breeds. However, the difference in the pregnancy rate of the two breeds was not statistically significant ($p > 0.05$). The current result was in agreement with previous studies of Girmay *et al.* [15] who reported 32.17% pregnancy rate in cows in and around WukroKilteAwulaelo District and Zeuh *et al.* [25] who reported 29.41% in Chad using prostaglandin F2α. The average rate of pregnancy (32.17%) recorded in this study was higher than the national rate of pregnancy (27%) reported by Desalegn *et al.* [26]. However, the rate of pregnancy (26.88%) obtained after treatment with PGF2 α is lower than most of the previous findings obtained by certain authors [18,21,27,28,29] in African cattle breeds: Maure zebu (40%), N'Dama (52.5%), Gobra zebu (43.8%), Baoule (57%), Afrikaner, Brahman, Tswana Tuli zebus (37%) and Friesian and Ayrshire crosses with indigenous Tanzanian short horn zebu (60.2%). Similarly, the current result was much lower than the preliminary results of mass synchronization found in SNNPR (63%) and in Tigiray (62%) [22]. The rate of pregnancy was also less than the rate of pregnancy stated in the guideline, which underlined that 50% of prostaglandin responsive cows and heifers should conceive; and previous findings of Million [6](47.5%) and Woldu *et al.* [30] (48.3%). Such extreme discrepancy might be due to shortage of feed, heat stress, anestrus cattle, poor body condition and exposure of synchronized cows for local bulls immediately after insemination as evidenced in the field visit. In addition, lower pregnancy rates of cows in this study could be associated with several factors such as suckling, which could be the most important factor. Milk let down involves many hormones, especially prolactin [31], which had an effect on maintaining the corpus luteum (CL) in the ovaries. This will hinder the usual process of gonadotropin hormone secretion, which in turn prolongs the estrous cycle [32]. Furthermore, Salman [33] reported that suckling and poor nutritional administration were the main causes of low reproductive efficiency attributed to long calving, conception interval and reduced fertility. Problems associated with parturition could also be a factor affecting the low conception rate of cows. Infection at the time of parturition could extend the time to postpartum estrus. According to Sheldon *et al.* [34], the uterus is sterile for the period of pregnancy, but after parturition the uterine lumen was almost contaminated with a wide range of bacteria. Subsequently, 15%-20% of cows had clinical diseases such as postpartum endometritis and subclinical endometritis that continue for up to 3 weeks [34, 35].

In the current study, a significant difference ($p < 0.05$) was observed in the pregnancy rates of cows inseminated by natural heat and by synchronization. Higher rates of pregnancy were observed in those females inseminated from heat detection by natural estrus (32.07%) as compared to those by synchronization (26.88%) (Table 2). Although all of the cows in both breeds showed standing heat after estrus synchronization, the variation of pregnancy rates was very high. This could also be due to the failure of conception or early embryonic death [36]. Other factors such as genetics, ovarian dysfunction, uterine infection, semen quality, nutrition and environment might also contributed to the low pregnancy rates of cows under synchronization [37].

According to this study, a total of 194 calves were delivered. Of which, 86 were females while 108 were males (Table 3). Among these calves, 169 were obtained from those cows inseminated by natural estrus (heat) and 25 were obtained from those cows inseminated after heat detection by synchronization (Table 3). This finding clearly indicates that higher numbers of male calves were born than females. This difference might be associated with the semen from bulls. Bull semen had two populations of sperm cells. One consisted of X-chromosome-bearing sperm; the other consisted of Y-chromosome-bearing sperm. In contrast, all cattle ova contained an X chromosome. That is why when an X-chromosome-bearing sperm fertilized the ovum a female (XX) developed and when a Y-chromosome-bearing sperm fertilized the ovum, a male (XY) developed. Ratios of the number of male and female calves born were usually very close to 50:50 which was why the ability to select the gender of calves in advance could have a significant impact on the genetics and economics of dairy herd. The separation of X- and Y- chromosome-bearing sperm is accomplished with the use of a high-speed cell-sorter, called a flow cytometer. The X chromosome is larger and contains approximately 4% more DNA genetic material than the smaller Y chromosome. After sperms were treated with a fluorescent dye, the X-chromosome-bearing sperm glow brighter when exposed to a laser than Y-chromosome-bearing sperm because of their increased DNA content [38]. However, the semen used in this study was not screened out for sex preference of new born calves. As a result, the proportion of calves was higher in males rather than the more important females for dairy purpose.

CONCLUSION

From the findings of this study, it can be concluded that prostaglandin $F_2\,\alpha$ was effective to synchronize cows and heifers to come in heat within short period of time. However, the rate of pregnancy was found 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. In addition, only those cows that showed standing estrus should be inseminated.

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REFERENCES

1. Kailasam, M., 2003. Reproductive Performance of Dairy Cows following different Estrus Synchronization Protocols, pp: 1-157.
2. CSA., 2009/2010. Ethiopian Statistical Abstract. Addis Ababa, Ethiopia.
3. FAO, 2011. Annual Production Yearbook, FAO, Rome.
4. FAO, 2000. Annual Production Yearbook, FAO, Rome.
5. Gokhan, D., M.K. Sariban, K. Fikret and Y. Ergun, 2010. "The comparison of the pregnancy rates obtained after the ovysnch and doubledose PGF2 α+GnRH applications in Lactating Dairy cows", Journal of Animaland Veterinary Advances, 9(40): 809-813. Medwell Journals.
6. Million, T., J. Theingthan, A. Pinyopummin, S. Prasanpanich and T. Azage, 2011. "Oestrus Performance of Boran and Boranx Holstein Fresian Crossbred Cattle Synchronized with a protocol based on Estradiol benzoate or Gonadotrophin- Releasing Hormone".
7. Shamsuddin, M., M.M.U. Bhuiyan, T.K. Sikder, A.H. Sugulle, M.G.S. Alam and D. Galloway, 2001. Constraints limiting the efficiency of artificial insemination of cattle in Bangladesh. In radioimmunoassay and related techniques to improve artificial insemination programs for cattle reared under tropical and subtropical conditions. Proceeding of a final research co-ordination meeting organized by the joint FAO/IAEA. Division of nuclear techniques in food and Agriculture and held in Uppsala, Sweden.

8. Roelofs, J., F. Lopez-Gatius, R.H.F. Hunter, F.J.C.M. Van Eerdenburg and C.h. Hanzen, 2010. When is cow in estrus? Clinical and practical aspect. Theriogenology, 74: 327-344.
9. Macmillan, K.L., 2010. Recent advances in the synchronization of estrus and ovulation in dairy cows. Journal of Reproduction and development, 56: S42-S47.
10. Paul, A.K., M.G.S. Alam and M. Shamsuddin, 2011. Factors that limit first service pregnancy rate in cows at char management of Bangladesh. Livestock Research for Rural Development, 23: 57. http://www.lrrd.org/lrrd23/3/paul23057.htm(Accessed on August 2, 2014).
11. Aulakh, B.S., 2008. "*In vivo* Sex fixing in Dairy Animals to produce female progenies", Proceedings of the 15th congress of FAVA, Bangkok, Thailand, pp: 243.
12. Bambal, A.M. and Jais- Patel, 2011. "To study oestrus synchronization in crossbred animals and buffaloes in Navsari district". Vasudhara Dairy.
13. Timothy, W.W., 2003. Estrous Synchronization for Beef Cattle. Cooperative Extension Service. The University of Georgia College of Agricultural and Environmental Sciences, University Press, Georgia. pp: 1-5. T.W. Wilson and W.D. Gilson, 2005. Estrous detection aid for beef cattle.
14. FWAROD (FogeraWoreda Agricultural and Rural Development Office), 2014. Annual progress report for the year 2014.
15. Girmay, G., G. Berihu and W. Bahlibi, 2015. The Effect of One Shot Prostaglandin on Estrus Synchronization of Local and Holstein Friesian Cattle in and around WukroKilteAwulaelo District, Northern Ethiopia. Journal of Biology, Agriculture and Healthcare, 5: 7, 2015.
16. Teklebrhan, D., 2011. Estrus induction/ synchronization in cross and local dairy cattle with controlled internal drug release. MSc Thesis. Mekelle University.
17. Diriba, H., 2010. Estrus synchronization in cross breed dairy cattle with controlled internal drug release. DVM Thesis. Mekelle University.
18. Cisse, A.B., 1993. Synchronisation des chaleurs chez les vaches Ndamaetzébu Maure avec de la prostaglandineF22α. In: P.E.H. Diop, Ed., Maîtrise de la Reproduction etAméliorationGénétique des Ruminants. Apports des Technologies Nouvelles, pp: 21-26.
19. Lhoste, P. and J. Pierson, 1976. L'expérimentation de l'inséminationartificielle au Cameroun par importation de semencecongelée. II. Essai de synchronisation de l'Es-trussurfemelles Zébu. Revue d'Elevageet de MédecineVétérinaire des Pays Tropicaux, 29: 67-74.
20. Mbaye, M. and M. Ndiaye, 1993. Etude des chaleurset de la fertilité après untraitement de maîtrise de la reproduction chez la vachezébuGobra. In: P.E.H. Diop, Ed., Maîtrise de la Reproduction etAméliorationGéné- tique des Ruminants. Apports des Technologies Nouvelles, pp: 27-37.
21. Mbaye, M., 1979. Induction etsynchronisation chez la femelleallaitante post-partum. Mémoire, UNCEIA, Paris.
22. IPMS (Improving Productivity and Market success of Ethiopian Farmers), 2011. 14th Progress report, pp: 11-12.
23. Diaz, C.A., Ebru, G. Emsen, N. Tuzumen, M. yanar, M. kutluca and F. Koycegiz, 2005. "Reproductive Performance and Synchronization of oestrus in Brown Swiss and Holstein Frisian cows and heifers using PGF2α", Journal of Animal and Veterinary Advances., 4(5): 551-553. Grace Publications.
24. Gordon, I., 1996. Controlled Reproduction in cattle and Buffaloes. CAB. International (Ireland), 1: 133-160.
25. Zeuh, V., M. Logtene, Youssouf, N. Dingamtar and D. Dezoumbe, 2015. Evaluation of two methods of estrus synchronization of cattle in Chad Vol. 4, No. 1, 13-17 (2014) http://dx.doi.org/10.4236/ojas.2014.41002.
26. Desalegn, G., B. Merga, T. Azage and B. Kelay, 2009. Status of artificial insemination service in Ethiopia. In: The 17th Annual Conference of the Ethiopian Society of Animal Production (ESAP), Sept 24-26, 2009 Addis Ababa, Ethiopia, pp: 87-104. D.E. Noakes, Timothy, J. Parkinson and Gary C.W. England, 2001. Arthurs veterinary Reproduction and obstetrics. 8th edition, W.B. sounders company, pp: 424-430.
27. Buck, N.G., D. Light and A.D. Makabo, 1983. Concep- tion rates of beef cattle in Botswana following synchro-nisation of oestrous with closprosteneol. Animal Produc- tion, 80: 61-67.
28. Ouedraogo, A., 1989. Contribution à l'étude de la synch- ronisation des chaleurs chez la femelleBaoulé au Burkina Faso. Thesis, EISMV No. 4, Dakar, Senegal.

29. Mgongo, F.O.K., P. Mujuni and A. Kitambi, 2009. Pregnancy rates of crossbred dairy cattle synchronized using GnRH and one injection of PGF2alpha versus two injec- tions of PGF2alphaprior to insemination. Livestock Re-search for Rural Development, 21: 136. http://www.lrrd.org/lrrd21/8/ mgon21136.htm.
30. Woldu, T., T.T. Giorgis and A. Haile, 2011. Factors affecting conception rate in artificially inseminated cattle under farmer's condition in Ethiopia. Journal of Cell and Animal Biology, 5(16): 334-338, 30 December, 2011.
31. Shibaya, M., S. Murakami, Y. Tatsukawa, D.J. Skarzynski, T.J. Acosta and K. Okuda, 2006. Bovine corpus luteum is an extrapituitary site of prolactin production. Mol. Reprod. Dev., 73: 512-519.
32. Valergakis, G.E., G. Arsenos and G. Banos, 2007. Comparison of artificial insemination and natural service cost effectiveness in dairy cattle. J. Anim., 1: 293-300.
33. Salman, M.R., P. Polat, V. Kayacik and O. Abdurrahman, 2004. Effect of Some Reproductive and Metabolic Problems on Fertility Parameters in Dairy Cows. J. Turk. Vet. Anim. Sci., 28: 71-78.
34. Sheldon, M., J. Cronin and L. Goetze, 2009. Defining postpartum uterine disease and the mechanisms of infection and immunity in the female reproductive tract in cattle. Biol. Reprod., 81: 1025-1032.
35. LeBlanc, S.J., T.F. Duffield, K.E. Leslie, K.G. Bateman, G.P. Keefe, J.S. Walton and W.H. Johnson, 2002. Defining and diagnosing postpartum clinical endometritis and its impact on reproductive performance in dairy cows. J. Dairy Sci., 85: 2223-2236.
36. Jainudeen, M.R. and E.S.E. Hafez, 2000. Reproduction in Farm Animals. 7th edition. New York. Lippincott Williams and Wilkins.
37. Gordon, I., 2005. Reproductive technologies in Farm animals. Printed and bound in the UK by Cromwell Press. Trowbridge.
38. Dalton, C.J., 2007. Comparing gender-selected A.I. semen pregnancy results in heifers and cows. Western Dairy News. University of Idaho. September 2007, Volume 7, No. 8.