Research Article

Early Pregnancy Diagnosis in Dairy Cattle: Economic Importance and Accuracy of Ultrasonography

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Abstract | Early pregnancy diagnosis is essential for effective management of pregnant animals and early submission of non-pregnant animals for subsequent breeding to reduce calving to conception interval. The present study assessed the accuracy in early pregnancy diagnosis by ultrasonography and estimated the loss due to delayed identification of non-pregnant animals. Transrectal ultrasonography was used to diagnose the pregnancy in dairy animals (n=47) at 30 and 45 days post breeding. The sensitivity and specificity was found to be 92.30% and 97.05%, respectively, on day 30 and re-examination was done at day 45 for confirmation of pregnancy. Animals found positive for pregnancy by ultrasound scanning on day 30 post-breeding had significantly high concentrations of plasma progesterone (> 3ng/ml) on day 20 post-breeding. It was found that pregnancy diagnosis using ultrasonography 30 days after AI can reduce number of open days by 15 days and 30 days compared to per rectal examination, which is generally done on day 45 and day 60 post-breeding, respectively. It was found that one day increase in open period resulted in loss (rearing and milk costs) to the tune of INR 281 and INR 368 in Sahiwal and Karan Fries cows, respectively. It was calculated in Karan Fries cows that if the calving interval is reduced by 1 month due to early pregnancy diagnosis, the expected gain of life time productive days would be around 132 days, which in turn would lead to benefit of about INR 48466. It can be concluded that use of ultrasonography at an early date (at 30 days) post breeding is an effective method for accurate identification of non-pregnant animals to reduce the calving to conception interval in dairy animals.

INTRODUCTION

Identification of non-pregnant animals at the earliest day post-breeding is of prime importance for maintaining an optimum calving interval. Pregnancy diagnosis as early as possible after insemination helps in better management of pregnant animals and early submission of non-pregnant animals for subsequent breeding (Thompson et al., 1995; Fricke, 2002). Although several methods like non-return to estrus, estimation of progesterone in blood or milk, and ultrasonography are used to diagnose pregnancy in dairy animals, rectal examination during 45-60 days post-breeding continue to be the most common

method used for pregnancy diagnosis, especially under field conditions. By rectal examination, it is difficult to identify the pregnancy before 45 days. Ultrasonography offer a great scope for early pregnancy diagnosis and additionally the cases of early embryonic mortality, which can be misdiagnosed as pregnant by serum progesterone estimation, can be detected by ultrasonography more accurately. Although it is undeINRtood that delay in identifying non-pregnant animals post-breeding leads to economic loss, information on the quantitative estimation of such loss is scanty. Thus, the aim of the present study was to assess the accuracy of ultrasonography in early pregnancy diagnosis and to estimate the economic loss due to delayed identification of non-pregnant animals in an organized dairy herd.

MATERIALS AND METHODS

The study was conducted at Livestock Research Centre, NDRI, Karnal, on 47 animals [32 Karan Fries (KF) and 15 Sahiwal (SW) cows]. Animals were reared under loose housing system and fed 10% extra as per NRC (2001) recommendations. Standard management practices, as per the farm schedule, were followed to maintain animals healthy.

Transrectal-Ultrasonography
The transrectal ultrasonography (Aloka Prosound 2) was done at 30 days post breeding and repeated after 45 days post breeding for confirmation. The examiner maintained standard procedure for ultrasonography. Ultrasound scanning of the uterus and ovaries were made using a 6.5 MHz rectal linear probe (Aloka UST-5820-5, Aloka) for diagnosis and confirmation of pregnancy.

Plasma Progesterone Concentration
Blood sample collection was done on day 20 after artificial insemination. The blood sample were immediately centrifuged at 3000 g for 20 minutes to separate the plasma and then the plasma was stored in cryovials at -20 ^{0}C. The samples were analysed for progesterone estimation using Bovine Progesterone Hormone (P_4) ELISA test Kit (Endocrine Technologies, Inc. Newark, CA).

Statistical analysis
The sensitivity and specificity of ultrasonography examination were calculated as per Broaddus and De Vries, (2005):

Sensitivity = No. of animals correctly diagnosed as pregnant / No. of animals correctly diagnosed as pregnant + Non-pregnant declared wrongly as pregnant

Specificity= No. of animals correctly diagnosed as Non-pregnant/ No. of animals correctly diagnosed as Non-pregnant + pregnant declared wrongly as non-pregnant.

Calculation of losses
Per day losses were calculated by adding per day costs of feed, labour and losses of milk. Wet average of SW (71 milking and 74 dry cows) was calculated as 7.3 litres and for KF (127 milking and 52 dry cows) wet average was 10.5 litres (LRC, NDRI Karnal). The overall losses were calculated by multiplying per day loss with number of open days. Labour rates were kept as per current local rates of Haryana (Labour Law Reporter, 2014). The procurement price for cow's milk was kept at INR 22/litre as per the local prevailing rate.

RESULTS

The transrectal ultrasonography done at 30 days post-breeding showed sensitivity and specificity of 92.30% and 97.05% and re-examination was done on day 45 for confirmation of pregnancy (Table 1). The USG scan of pregnant cows is depicted in Figure 1. Plasma progesterone concentration ranged from 3.19 to 4.97 ng/ml on day 20 after AI in pregnant animals. Non-pregnant animals showed significantly (P<0.05) lower plasma progesterone concentration at 20 days post-AI (0.39 to 0.88 ng/ml) compared to pregnant animals.

EXPECTED REDUCTION IN NUMBER OF OPEN DAYS DUE TO EARLY PREGNANCY DIAGNOSIS
By using ultrasonography at 30 days after AI, the non-pregnant animals can be identified at least 15 days and 30 days earlier when compared to the standard per rectal examination that is generally conducted on day 45 and day 60, respectively.

EXPECTED ECONOMY OF EARLY PREGNANCY DIAGNOSIS
The cost of rearing (feeding and labour cost) for maintaining SW and KF cow/day was estimated to be INR 120 and INR 137, respectively. The losses due to milk

Table 1: Details of the cows subjected to trans-rectal ultrasonography

1	No of animals scanned	47
2	No of animals non pregnant	34
3	No. of animals diagnosed pregnant at 30 days	12
4	No. of animals actually pregnant at 30 day	13
5	Pregnant diagnosed as non-pregnant (false negative)	1
6	Non pregnant diagnosed as pregnant (false positive)	1
7	No. of animals pregnant at 45 days	12
8	No. of embryonic deaths between 30-45 days	1
9	Embryonic mortality rate between 30-45 days	7.69%
10	Sensitivity of ultrasonography on 30 day	92.30%
11	Specificity ultrasonography on 30 day	97.05%
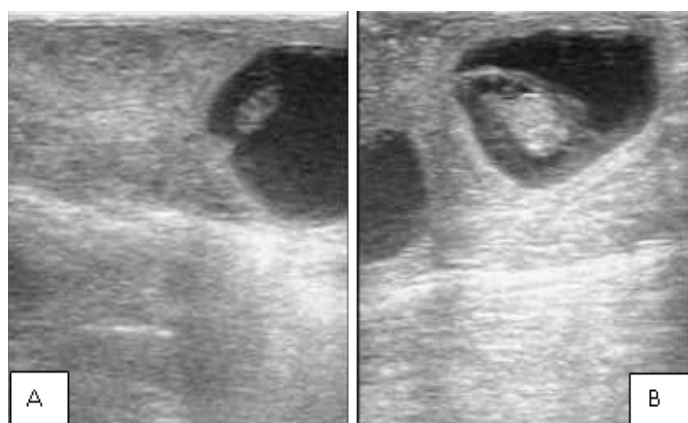
Figure 1: Ultrasound image of 30 days (A) and 45 days (B) pregnancy in Karan Fries cows.

were calculated as INR 161 in SW and INR 231 in KF. It was found that total per day loss due to one day increase in open period due to delay in pregnancy diagnosis in SW and KF cow was INR 281and INR 368, respectively. Early pregnancy diagnosis on 30th day post service would benefit about INR. 4215 for SW and INR. 5520 for KF cows by reducing the number of open days of around 15 days compared to per rectal examination done on 45 days post service.

CALCULATION OF EXPECTED LIFE TIME BENEFITS FROM KF DUE TO EARLY PREGNANCY DIAGNOSIS

The average productive life of KF is 1604 days, i.e. 4.39 yINR. (Sharma, 2010). Increase of productive days in the life time when calving interval is reduced by 1 month in each lactation due to early pregnancy diagnosis would be 4.39 × 30 = 131.7 days. Therefore, the amount of life time benefits in KF would be INR 48466.

DISCUSSION

Sensitivity and specificity of pregnancy diagnosis by ultrasound at 30 days in this experiment are comparable with observations of Filteau and DesCôteaux, (1998) who demonstrated sensitivity of ultrasonography greater than 95% at day 26 post-insemination. Ultrasonography from day 28 of pregnancy allows obtaining a predictive value of 95% for a negative test (Filteau and DesCôteaux, 1998). Similarly, PieteINRe et al. (1990) found sensitivity and specificity of pregnancy diagnosis with ultrasound as 44.8 and 82.3%, respectively, when conducted between 21 and 25 days post AI but increased to 97.7 and 87.7%, respectively, when conducted between 26 and 33 days post AI, which is similar to our results. In the present study low sensitivity (7.69 %) at 30 days of pregnancy might be due to early embryonic mortality. The incidence of early embryonic mortality in the present study was in accordance with the observations made by Whitlock and Maxwell (2008) (5–10%; 28 to 42 days) in lactating dairy cows and by Silke et al. (2002) (3.2%; at more than 27 days) in low producing cows. Therefore, it can be concluded that on 30 days post breeding, the sensitivity and specificity is acceptable to efficiently diagnose a pregnant/non-pregnant cow. Animals diagnosed as pregnant by ultrasound scanning on day 30 showed significantly increased value of plasma progesterone concentration on day 20 i.e. > 3ng/ml, which is minimum concentration required for maintenance of pregnancy.

Similarly, DesCoteaux and Fetrow (1998) calculated the cost of a day open was around $4. Rosenbaum and Warnick (2004) and Filteau and DesCôteau (1998)

observed a reduction of 7-9 days open when ultra-sound was used for early pregnancy diagnosis at day 30. Filteau and DesCôteau (1998) also calculated that the total amount saved due to the early pregnancy diagnosis through ultrasound was $10,080 per 1000 HF cows. Oltenacu et al. (1990) found that the value of increasing in sensitivity and specificity from 95% to 97.5% was worth $0.10 to $4.70 per cow. De Vries et al. (2005) observed that a reduction in sensitivity and specificity from 98% to 92% reduces net revenue by $10 to $20 per cow per year. Pregnancy diagnosis on 35th or 50th post service day was profitable with a net return of $5.10 and $2.5 per cow, respectively (Olte-nacu et al., 1990).

In the present study the economic return due to early pregnancy diagnosis at 30 days by USG was around INR 4215 for SW and INR 5520 for KF cows, which was comparable to the studies reported earlier.

CONCLUSIONS

The use of ultrasonography at an early date is an accurate method for identification of pregnant and non-pregnant animals and may help reduce the calving to conception interval. Transrectal ultrasonography done at 30 days showed sensitivity and specificity of 92.30% and 97.05%, respectively. The economic benefit through early pregnancy diagnosis at 30th day post service by USG was INR 4215 in Sahiwal and INR. 5520 in Karan Fries cows by reducing the number of open days of around 15 days compared to per rectal examination done on 45 days post service.

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CONFLICT OF INTEREST

The authoINR have no conflict of interests.

REFERENCES

- Broaddus BMS, de Vries A (2005). A comparison of methods for early pregnancy diagnosis. Proceedings 2nd Florida Dairy Road Show. http://dairy.ifas.ufl.edu/dINR/2005/Broaddus.pdf
- DesCoteaux L, Fetrow J (1998). Does it pay to use an ultrasound machine for early pregnancy diagnosis in dairy cows? Proceedings 31st AABP annual meeting, Spokane 172-174.
- De Vries A, Leeuwen AJ, William WT (2005). Economics of Improved reproductive performance in dairy cattle. Florida cooperative extension service, Institute of food and agricultural sciences, Department of animal sciences, UniveINRity of Florida, Gainesville, 32611, Publication #AN156, http://edis.ifas.ufl.edu/an156.
- Labour Law Reporter (2014). http://www.labourlawreporter.com/minimum-wages-in-haryana-revised/
- Filteau V, DesCoteaux L (1998). Predictive values of early pregnancy diagnosis by ultrasonography in dairy cattle. Proc AABP Annu Meeting, Spokane, WA 31: 170-171.
- Fricke PM (2002). Scanning the future—ultrasonography as a reproductive management tool for dairy cattle. J. Dairy Sci. 85: 1918–1926.
- NRC (2001) Nutrient Requirements of Dairy cattle: Seventh Revised Edition. Washington DC: The National Academic Press, 2001.
- Oltenacu PA, Ferguson JD, Lednor AJ (1990). Economic evaluation of pregnancy diagnosis in dairy cattle: A decision analysis approach. J. Dairy Sci. 73: 2826-2831.
- PieteINRe MC, Szenci O, Willemse AH, Bajcsy CSA, Dieleman SJ, Taverne MAM (1990). Early pregnancy diagnosis in cattle by means of linear-array real-time ultrasound scanning of the uterus and a qualitative and quantitative milk progesterone test. Theriogenol. 33: 697–707.
- Rosenbaum A, Warnick LD (2004). Pregnancy diagnosis in dairy cows by palpation or ultrasound: a survey of US Veterinarians: Proceedings 37th AABP Annual Meeting, Forth Worth, TX Proceedings: 198p. 37th AABP Annual Meeting, Forth Worth, TX. 198.
- Sharma PC (2010). Genetic evaluation of Karan Fries cows for functional traits. Ph.D. thesis submitted to National Dairy Research Institute (Deemed UniveINRity), Karnal, Haryana, India.
- Silke V, Diskin MG, Kenny DA, Boland MP, Dillon P, Mee JF, Sreenan JM (2002). Extent, pattern and factoINR associated with late embryonic losses in dairy cows. Anim. Reprod. Sci. 71: 1–12.
- Thompson JA, MaINRh WE, Etherington WG, Momont HW, Mark LK (1995). Evaluation of the benefits of the timing of pregnancy testing by transrectal palpation in dairy cattle. J. American Vet. Med. Asso. 207: 1462-1465.
- Whitlock BK, Maxwell HS (2008). Pregnancy-associated glycoproteins and pregnancy wastage in cattle. Theriogenol. 70: 550–559.