VETERINARSKI ARHIV 84 (5), 513-519, 2014

Efficacy of prepartal vitamin E and selenium administration on fertility in Indian yaks (*Poephagus grunniens*)

Sourabh Deori*, Joken Bam, and Vijay Paul

National Research Centre on Yak, Indian Council of Agricultural Research, Dirang, West Kameng District, Arunachal Pradesh, India

DEORI, S., J. BAM, V. PAUL: Efficacy of prepartal vitamin E and selenium administration on fertility in Indian yaks (*Poephagus grunniens*). Vet. arhiv 84, 513-519, 2014.

ABSTRACT

Yaks are the main source of livelihood for the highlanders in India as major agriculture is meager in yak inhibiting tracts due to adverse agro-climatic conditions. Under field condition, the reproduction in yak is seasonal which could be due to lack of feed and stress rather than inherent characteristics. The aim of the study was to check efficacy of vitamin E and selenium parenteral administration during late gestation period on postpartal fertility in yak. Altogether 21 yak cows were randomly divided into 3 groups (two treatment groups and controls) with 7 animals each. The animals within both treated group received a commercial preparation containing DL- alpha Tocopheryl Acetate equivalent to Tocopherol (vitamin E) 50 mg/mL and Sodium selenite 1.5 mg/mL intramuscularly. Treated groups received the drug twice in 7 days interval 30 to 40 days prior to calving in the amount of 5 mL and 10 mL in group I and II respectively. The study showed that administration of vitamin E and selenium during late gestation can significantly ($P<0.05$) improve fertility in group II animals..

Key words: fertility, selenium, vitamin E, yak

Introduction

The natural habitat of yak spreads from 3000 to 6000 m above m.s.l. in the middle and inner Himalayas. The average temperature in natural habitat in summer varies from 4 °C to 6 °C while in the winter; minimum temperature even reaches -40 °C to -50 °C. All available literatures in this species indicate that yaks are seasonally polyestrous and breeding occurs from July to November. The yak's seasonal reproduction is the most probably result of thermal stress and lacking of pasture rather than inherent characteristics (SARKAR et al., 2006). The season affects reproductive cycle and production in yaks since

*Corresponding author:

Dr. S. Deori, M.V.Sc. National Research Centre on Yak, Indian Council of Agricultural Research, Dirang, West Kameng District, Arunachal Pradesh 790101, India, Phone: +91 3780 200 075, Fax: +91 3780 242 273, E-mail: sourabhd1@rediffmail.com

ISSN 0372-5480
Printed in Croatia

postpartal anoestrus period is shorter in yaks having good body condition compared to those with poor body condition (LIU and LIU, 1987). During cold period the yaks have poor body condition score due to non availability of pasture and it improves during warm period of the year. The occurrence and duration of postpartal anoestrus period in yak is highly dependent on the availability of nutrients in pasture. Yaks must increase their metabolism during winter to maintain the body temperature and if the nutrition is not sufficient during this period it leads to decreasing weight and body condition. If postpartal females became pregnant again in the same year, their body condition and fetal development will be severely affected, resulting in abortion and anoestrus. Therefore, they are most likely to calve once in every 2 years or twice in 3 years.

The free radicals can decrease reproductive function acting in several ways including disruption of steroids synthesis (TAKAYANAGI et al., 1986; STAATS et al., 1988), prostaglandins (MARSHALL, 1987) and embryonic development (GOTO et al., 1992). Vitamin E acts as antioxidant by maintaining the integrity of phospholipids against oxidative damage (DARGEL, 1992). Among enzymes, glutathione peroxidase is a selenium dependent enzyme that utilizes electrons from glutathione and other thiols to convert peroxides to water (FLOHE and GUNZLER, 1976). Concentration of α tocopherol typically drops 7 to 10 d before calving and remain low during week 1 and week 2 of lactation even when dietary Vitamin E offered to cows is constant throughout the dry period (WEISS et al., 1990).It is possible that antioxidants can decrease the incidence of retained foetal membranes, enhance the overall uterine health and improve fertility in yak.

It was reported that administration of vitamin E and selenium or their combination during the late pregnancy could result with earlier placental expulsion (QURESHI et al., 1997; SATTAR et al., 2007), reduced incidence of retained placenta (ARECHIGA et al., 1994) and metritis (HARRISON et al., 1984), early uterine involution (SATTAR et al., 2007), decreased number of days open and less number of services per conception (SATTAR et al., 2007; MOEINI et al., 2009). Improved fertility rate following administration of vitamin E and selenium during the late gestation period was previously reported for cows (ARECHIGA et al., 1994; SATTAR et al., 2007), heifers (MOEINI et al., 2009) and buffaloes (QURESHI et al., 1997). Yet, no reports of these effects in yaks exist.

The principal aim of the study is to check the influence of vitamin E and selenium parenteral administration during the late gestation period on the postpartal fertility measured by the time from the partus until placental expulsion, calving abnormalities, time required for uterine involution, days from calving until the first oestrus, number of days open and the numbers of artificial insemination (AI) until pregnancy.

Materials and methods

Animals. Twenty one yak cows free from apparent diseases kept at yak farm of the National Research Centre on Yak, Dirang, Arunachal Pradesh, India under similar management were included in the study. Included animals ranged from 2nd to 5th lactation and pregnant for 7 months were randomly divided into three groups. All animals were offered seasonal grass *ad libitum* and concentrates of maize, groundnut cake, wheat bran with additional salt and minerals yet without vitamin E and selenium.

Experimental protocol. The group I of animals received parentally a commercial preparation containing DL- alpha Tocopheryl Acetate equivalent to Tocopherol (vitamin E) 50 mg/ml and Sodium selenite 1.5 mg/mL at the rate of 5 mL twice in 7 days interval. The first dose was administered 40-30 days prior to the expected date of calving and the second dose 7 days later. The animals within group II received the same drug administrated by same protocol, yet the dose was twice as high compared to group I. Animals within group III served as controls and received no treatment. Any calving abnormalities like dystocia, retention of foetal membranes, calf mortality, time from partus until placental expulsion, time required for uterine involution, number of days for first oestrus to occur, number of days open and the number of AIs until pregnancy were recorded for further statistical analysis. Retention of foetal membranes was considered if the placenta was not expelled within 24 hours of delivery of fetus. The uterine involution was checked by rectal palpation starting from one week postpartum and performing twice a week until completion as per SATTAR et al. (2007).

Starting from 10 days postpartum, the animals were monitored for possible oestrus signs twice daily. In animals having mucous, watery vaginal discharge noted externally on the vulva or internally, in vagina, and/or external cervical orifice using vaginoscopy, with characteristics signs of oestrus as well as in animals having dominant follicle on one of the ovaries and tonicity of uterine horns recorded by rectal palpation, the oestrus diagnosis was established. The animals were artificially inseminated once after 10 to 12 hours of onset of oestrus signs and semen was deposited into the uterine body. Semen originated from the same bull in order to avoid bull influence on the results. Pregnancy was confirmed by rectal palpation 60 days following AI by rectal palpation.

Mean values (±SE) of the various parameters in different groups were calculated. The data were subjected to *t* - test to access the significance, if any between the groups as per STEEL and TORRIE (1984). P value <0.05 was considered to be statistically significant

Results

The results are summarized in Table 1 and presented as influence of the group on the outcome measured parameters. All recorded fertility outcomes including the time for placental expulsion, the number of animals having calving abnormalities, time required

for complete uterine involution, days from calving until the first oestrus, number of days open and the number of artificial inseminations until pregnancy was superior for both treated groups compared to controls. No calving abnormalities were recorded in both the treated groups. In the untreated control group out of total seven animals one resulted to retention of foetal membranes and another one had stillbirth. Yet, statistically significant ($P<0.05$) results for measured outcomes were recorded only between treatment group II and controls.

Table.1. Influence of the group on fertility in yak

Parameters	Group I (5 mL)	Group II (10 mL)	Group III (control)
Placental expulsion period (hrs)	$5.90^{ab} \pm 0.76$	$3.81^{a} \pm 0.31$	$6.16^{b} \pm 1.05$
Percent calving abnormalities	0.00	0.00	28.6
Uterine involution period (days)	$31.83^{ab} \pm 0.70$	$29.33^{a} \pm 0.49$	$34.83^{b} \pm 1.51$
Calving to first estrus interval (days)	$143.51^{ab} \pm 17.09$	$110.25^{a} \pm 7.56$	$162.04^{b} \pm 21.36$
Days open (days)	$171.36^{ab} \pm 17.03$	$140.53^{a} \pm 12.12$	$185.30^{b} \pm 23.11$
Number of services per conception	$2.91^{ab} \pm 0.96$	$2.13^{a} \pm 0.83$	$3.21^{b} \pm 0.71$

[a,b] Values within the row marked with different letters in superscript differ significantly; Group I (n = 7): animals received 5 mL of vitamin E and selenium twice in 7 days period; Group II (n =7): animals received 10 mL of vitamin E and selenium twice in 7 days period; Group III (n = 7): animal receiving no prepartal treatment (controls).

Discussion

Our study showed increase in all measured postpartal fertility parameters within both treatment groups (group I and II) compared to controls, yet statistically significant results were recorded only for animals within group II compared to control ($P<0.05$).

As reported by CHARMLEY et al. (1992), the single vitamin E and selenium administration several weeks prior the partus has a long term beneficiary effect on fertility in bovines. According to MAAS (1990) and GERLOFF (1992) selenium acts as antioxidant and thus increases general cell viability, immune response and muscular contractions resulting with earlier foetal membranes expulsion, proper uterine involution and improved subsequent overall fertility in cattle. As reported by BRZEZINSKA-SLEBODZINSKA et al. (1994), selenium acts as a part of glutathione peroxidase enzyme by removing the free radicals within body, thus minimizing oxidative stress and decreasing the incidence of retained foetal membranes. In present study, differences concerning the time required for placental expulsion between group II and controls could be the result of improved uterine smooth muscle function, as previously reported by YOUSEFF et al. (1985), KIM et al. (1997) in cows, and MALVI et al. (2006) in buffaloes. AWAD et al. (1985) and YOUSSEF et al. (1995) reported that pregnant cows are more susceptible to selenium deficiency than non

pregnant animals, which in turn increase the incidence of pre and postpartal reproductive disorders. Furthermore, as reported by AWAD et al. (1985) and EL-WISHY (2006), vitamin E and selenium are essential for proper function of various reproductive characteristics in mammalian females. This study results are in concordance with cited reports providing significantly improved overall postpartal fertility rate within animals of group II compared to untreated animals. In addition, our study results showed decrease in number of days open for the animals within group II compared to group I and controls. It is likely that selenium and vitamin E improved resumption of ovarian activity by contributing to progesterone production by corpus luteum (KAMADA and HODATE, 1998). As shown, administration of vitamin E and selenium during late gestation period acts beneficiary on the puerperal health and fertility. In the present study, animals in treated groups required lesser services per conception in compared to the controls. Similar results in cows were reported by earlier workers (ARECHIGA et al., 1994; SATTAR et al., 2007). Administration of antioxidants can improve fertility because it eliminates pregnancy losses due to uterine infection as a sequel to retention of placenta and secondly, the oocytes and pre-implantation embryos which are susceptible to damage by ROS (FAVETTA et al., 2007; MOSS et al., 2009) are prevented.

Conclusion

In summary, presented results suggest positive influence of vitamin E and selenium supplementation on the overall fertility resulting in shorter foetal membranes expulsion period, less number of animals having calving abnormalities, shorter time required for the uterine involution, less number of days from partus until the first oestrus, less number of days open and less number of AI until pregnancy in yaks. This study presents the very first report of vitamin E and selenium supplementation in order to improve fertility in yaks. However, the number of animals used in the study is small but the results are of significance, yet the results need to be checked and confirmed in a larger scale study.

References

ARECHIGA, C. F., O. ORTIZ, P. J. HANSEN (1994): Effect of prepartum injection of vitamin E and selenium on postpartum reproductive function of dairy cattle. Theriogenology 41, 1251-1258.

AWAD, Y. L., H. YOUSSEF, M. F. MIKHALI (1985): Influence of prepartum selenium treatment on the reproductive pattern of Egyptian buffaloes and on the born calves. Egypt J. Vet. Sci. 22, 55-60.

BRZEZINSKA-SLEBODZINSKA, E., J. K. MILLAR, J. D. QUINGLEY, J. R. MOORE, F. C. MADSEN (1994): Antioxidant status of dairy cows supplemented prepartum with vitamin E and selenium. J. Dairy Sci. 77, 3087-3095.

CHARMLEY, E., N. HIDIROGLOU, L. OCHOA, R. McDOWELL, H. HIDIROGLOU (1992): Plasma and hepatic α- tocopherol in cattle following oral or intramuscular supplementation. J. Dairy Sci. 75, 804-810.

DARGEL, R. (1992): Lipid peroxidation-a common pathogenetic mechanism. Exp. Toxicol. Pathol. 44, 169-181.

EL-WISHY, A. B. (2006): The postpartum buffalo: I. Endocrinological changes and uterine involution. Anim. Reprod. Sci. 97, 201-215.

FAVETTA, L. A., J. St JOHN, W. A. KING, D. H. BETTS (2007): High levels of p66shc and intracellular ROS in permanently arrested early embryos. Free Radical Biol. Med. 42, 1201-1210.

FLOHE, L., W. A. GUNZLER (1976): Glutathione - dependent enzymatic oxidoreduction reactions. In: Glutathione: Metabolism and functions. (Arias, I. M., W. B. Jakoby, Eds.), New York, Raven Press pp. 17-34.

GERLOFF, B. J. (1992): Effect of selenium supplementation on dairy cows. J. Anim. Sci. 70, 3934-3940.

GOTO, Y., Y. NODA, K. NARIMOTO, Y. UMAOKA, T. MORI (1992): Oxidative stress on mouse embryo development *in vitro*. Free Radical Biol. Med. 13, 47-53

HARRISON, J. H., D. D. HANCOCK, H. R. CONRAD (1984): Vitamin E and selenium for reproduction of dairy cow. J. Dairy Sci. 67, 123-132.

KAMADA, H., K. HODATE (1998): Effect of dietary selenium supplementation on the plasma progesterone concentration in cows. J. Vet. Med. Sci. 60, 133-135.

KIM, H. S., J. M. LEE, S. B. PARK, S. G. JEONG, J. K. JUNG, K. S. IM (1997): Effect of vitamin E and selenium administration on the reproductive performance in dairy cows. Asian-Aus. J. Anim. Sci. 10, 308-312.

LIU, W. L., S. Y. LIU (1982): Observation and analysis of female yaks characteristics of Quinghai yak. China Yak 3, 27-28.

MAAS, J. (1990): Selenium deficiency in cattle. Proceeding of the 16th World Buiatrics Cogress, Salvadoe, Brazil, pp. 5-14.

MALVI, P. S., G. R. PANGAONKAR, R. K. SHARMA (2006): Effect of vitamin E and selenium on postpartum reproductive performances of buffaloes. Indian J. Anim. Sci. 76, 308-310.

MARSHALL, P. J., R. J. KULMACZ, W. E. M. LANDS (1987): Constraints on prostaglandin biosynthesis in tissues. J. Biol. Chem. 262, 3510-3517.

MOEINI, M. M., H. KARAMI, E. MIKAEILI (2009): Effect of selenium and vitamin E supplementation during the late pregnancy on reproductive indices and milk production in heifers. Anim. Reprod. Sci. 114, 109-114.

MOSS, J. L., E. PONTES, P. J. HANSEN (2009): Insulin-like growth factor - 1 protects preimplantation embryos from anti-developmental actions of menadione. Arch. Toxicol. 83, 1001-1007.

QURESHI, Z. I., L. A. LODHI, A. SATTAR (1997): An apparent effect of immunopotentiation during late gestation on the postpartum reproductive performance of Nili-Ravi buffaloes (*Bubalus bubalis*). Vet. Res. Com. 21, 375-380.

SARKAR, M., H. D. MEYER, B. S. PRAKASH (2006): Is the yak (*Poephagus grunniens*) really a seasonal breeder? Theriogenology 65, 721-730.

SATTAR, A., R. H. MIRZA, S. M. I. HUSSAIN (2007): Effect of prepartum treatment of vitamin E-selenium on postpartum reproductive and productive performance of exotic cows and their calves under subtropical conditions. Pak Vet. J. 27, 105-108.

STAATS, D. A., D. P. LOHR, H. D. COLBY (1988): Effects of tocopherol depletion on the regional differences in adrenal microsomal lipid peroxidation and steroid metabolism. Endocrinol. 123, 975-980.

STEEL, R. G. D., J. H. TORRIE (1984): Principles and procedures of statistics: A biometrical approach. 2nd ed., McGraw Hill, Tokyo, Japan.

TAKAYANAGI, R., K. I. KATO, H. IBAYASHI (1986): Relative inactivation of steriodogenic enzyme activities of *in vitro* vitamin E - depleted human adrenal microsomes by lipid peroxidation. Endocrinol. 119, 464-469.

WEISS, W. P., D. A. TODHUNTER, J. S. HOGAN, K. L. SMITH (1990): Effect of duration of supplementation of selenium and vitamin E on periparturient cows. J. Dairy Sci. 73, 3187-3194

YOUSSEF, R. H., Y. L. AWARD, M. F. MIKHALI (1985): Effect of prepartum selenium treatment on retained placenta in buffaloes and on their subsequent fertility. Egypt J. Vet. Sci. 22, 65-71.

Received: 24 August 2013
Accepted: 28 March 2014

DEORI, S., J. BAM, V. PAUL: Učinak prepartalne primjene vitamina E i selena na reprodukcijske funkcije indijskih jakova (*Poephagus grunniens*). Vet. arhiv 84, 513-519, 2014.

SAŽETAK

Jakovi su glavni izvor za preživljavanje stanovništva u brdovitim područjima koja su karakterizirana različitim agro-klimatskim uvjetima i slabom poljoprivrednom aktivnošću. U prirodnim uvjetima jakovi se razmnožavaju sezonski, što je više posljedica pomanjkanja hrane i djelovanja stresa nego nasljednih obilježja. Uvažavajući navedeno, ovo istraživanje je imalo za cilj utvrditi može li jednokratna intramuskularna injekcija antioksidanata (vitamin E i selen) u kasnom prepartalnom razdoblju imati učinke na reprodukcijske pokazatelje jakova. Životinjama je primijenjen komercijalni preparat koji je sadržavao 50 mg/mL DL-alfa tokoferil acetata, ekvivalentan tokoferolu (vitaminu E), i 1,5 mg/mL natrijeva selenita. Pripravak je bio primijenjen intramuskularno, dvokratno u dozi od 5 mL i 10 mL, u razmacima od tjedan dana. Prva aplikacija uslijedila je između 30 i 40 dana prije teljenja. Životinje koje su primile 10 mL pripravka pokazale su statistički značajno ($P<0,05$) poboljšanje reprodukcijskih pokazatelja. Na osnovi istraživanja može se zaključiti da primjena antioksidanata neposredno prije teljenja može pridonijeti unaprjeđenju reprodukcijskih funkcija u indijskih jakova.

Ključne riječi: prepartalno razdoblje, selen, vitamin E, jak