Nutritional and Other Management Practices for Optimum Semen Production in Buffalo Bulls

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ABSTRACT
To support the genetic improvement programme there is a need to produce quality semen from genetically superior bulls. This would entail maximum utilization of males through frozen semen technology with high fertility. Proper feeding management of the young bulls becomes more important for production of quality semen. However, bull’s feeding generally is not given due importance as a result its age at puberty and first semen collection get delayed. One of the major constraints in the exploitation of the potential of buffalo bull is a sharp seasonal trend in semen quality. It exerts its effect on reproductive performance through macro and micro climatic factors like temperature, humidity, rainfall, photo-period. Therefore suitable nutritional and management strategies are being searched for and incorporated so as to maximize quality semen production without discarding too many poor quality ejaculates.

Keywords: buffalo bulls, nutrition, puberty age, season effect, semen quality,

INTRODUCTION
A breeding bull is said to be half of the herd, as it sires the whole herd. Therefore, the importance of genetically superior bull as a producer of large quantities of normal fertile spermatozoa in any programme of natural and/or artificial breeding/insemination is obvious. The bull that has a high economical value attached with it; have to be maintained on proper nutrition and management to obtain optimum performance in terms of growth and semen production. However, bull’s feeding generally is not given due importance as a result its age at puberty and first semen collection get delayed. Obtaining semen at the earliest possible age from bulls is not only economical but also may increase productive life span and genetic testing of bulls at an early age. The onset of puberty is more closely related to body weight than the age and nutritional level modulates age at puberty. Thus nutrition ranks high among factors that control generation and output of sperms and accessory fluids in the male. But when we talk of nutrition, the environment and management goes with it and only one aspect cannot be taken in isolation. Weak and erratic libido is characteristically an inherent trait which the buffalo bull possesses. It has been found that semen collected during November (winter) produced significantly higher conception rate (40.9\%) than semen collected in June (summer) (34.0\%). It was attributed 40\% of the seasonal variation of buffalo fertility to the male (Heuer et al., 1987).

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OPTIMUM SEMEN PRODUCTION

The bulls to be used as semen donors must be selected at the age of 16-18 months. Breed, age, size, feed intake, play an important role in bringing on puberty in buffalo males. The following points must be taken into account to decide if a buffalo male will be a semen donor. The first step of bull selection is to know his ancestor’s history concerning milk or meat production. Once selected as semen donor a bull must be subjected to general clinical examination to find out any reproductive, pathological condition, chromosomal defects or any hereditary disease. Also the bull must be tested for some infectious contagious disease such as brucelosis, vibriosis, bovine viral diarrhoea (BVD) etc. It is important that young bulls selected for semen collection must be maintained alone in individual barns however, it is recommended to put them together once or twice a day with other young bulls in order to acquire homosexual behaviour an aspect very important for semen collection. Vale, 1994a has enumerated characteristics of normal buffalo ejaculate viz. Colour, white, milky with light blue tinge; Volume, 3 ml (2-8); Wave or swirl motion, > 3; Motility, > 70%; Vigour (individual motility), > 3; Concentration, 6 x 10^5 to 12 x 10^5; Live sperm, > 70%; Abnormal sperm, < 30% and pH, 6.5-7.5.

FACTORS AFFECTING OPTIMUM SEMEN PRODUCTION

Sexual Maturity

Contradictory reports are available in literature about the age at maturity and first ejaculation. The first signs of sexual interest and meiotic divisions of spermatogonial cells were found to occur as early as 9 month and age of puberty and first ejaculation in Egyptian buffalo bulls (14.2 month) is reasonably early (Ali et al, 1981). In another observation at NDRI, Karnal, a cloned buffalo bull, which was kept on intensive care with extra ordinary management, had donated the first ejaculate at the age of 18 months with a body weight of 450 kg which comes around 830 gm/d growth rate and 30 cm scrotal circumference. However, in spite of early puberty, bulls in Egypt are put to service at about 3 - 3.5 years of age and so are the bulls in India. Semen of best quality, with regard to sperm morphology, was observed in 3- to 5-year-old Murrah (Kumar et al., 1993; Chinnaiya and Ganguli, 1990; Singh et al., 2004) and Nili–Ravi buffalo bulls (Saeed et al., 1990). There were significant differences in the quality of semen of individual bulls (Mohan and Sahni, 1990; Galli et al., 1993; Kumar et al., 1993).

Nutrition

The feeding of the buffalo bulls has an influence on the production and quality of the semen (Chinnaiya and Ganguli, 1990, Dahiya et al., 2006). The level of feeding at various stages of growth seems to have an important influence on male and female reproductive performance. Severe under-nutrition or over-feeding and deficiency of specific nutrients are the most common causes of impaired reproductive capability of the bull in terms of semen production and quality. Moderate to severe nutritional deficiency, especially in rural buffaloes, due to feed shortage and/or poor quality feed leads to delayed puberty in buffalo bulls associated with loss of libido, depressed spermatogenesis and poor semen quality (Pant, 2002).
Season

The effect of season is both direct and indirect. It affects the animal directly through macro and micro climatic factors, which are the temperature, humidity, rainfall and photo-period. High heat stress during summer is known to depress the libido, semen quality and fertility of breeding buffalo bulls (Pant, 2000). Photoperiod is an important environmental factor influencing reproduction and sexual activity of buffalo bulls (Vale, 1997). In the temperate regions of the world, it has been found that the semen is of better quality during the winter and spring than in summer and autumn (Galli et al., 1993; Mohan and Sahni, 1990). In the tropical regions, the quality of semen was observed to be satisfactory during the rainy season. In the warm and humid tropical Amazon region, the best time to obtain semen is between January and June (Vale, 1994b). Winter and spring are the favorable season for the semen production and hot and humid are the unfavorable season in buffaloes (Maink, 1984; Tuli, 1984).

Management

The effect of age, body size, body weight, scrotal circumference on the ability of buffalo male to produce semen has long been recognized. (Pant et al., 2003). In addition to nutrition, housing conditions also influence the quality and quantity of semen. Safety, ease, protection from environment and provision for exercise are the key points while planning accommodation for a bull. No hard and fast rule can be fixed for frequency of collection however, for getting quality semen, judicious use of breeding bulls in terms of number of ejaculates per collection and frequency of collection is essential. It will certainly prolong the reproductive life of a breeding bull. Semen collection once a week is an ideal frequency for a young bull between the age of 2-3 years. Thereafter two successive ejaculates with a time interval of 30 minutes, twice a week can be collected for harvesting good quality semen. As a regular prophylactic measure, breeding bulls are vaccinated against various contagious diseases. semen quality is affected by vaccination (Venkatareddy et al., 1991) as it is one of the major stress factors which cause rise in body temperature because of the febrile reaction occurring during post-vaccination period.

REMEDIAL MEASURES

Realistic remedial measures for optimum semen production includes:

1. Modifying nutritional environment
2. Ameliorating heat stress
3. Improving management practices

1. Modifying nutritional environment

Appropriate feeding and management of prepubertal buffalo bulls is thought to be of value, if bulls are to be prepared for breeding at right age. The feeding standards for maintenance and growth requirements of energy and protein are generally based on observation on female; it is possible that they underestimate the requirements of male. The feeding management as being followed for growing buffalo calves is followed until they attain a body weight of 350-400 kg. For the growing bulls the diet should contain about 12 (10 to 14) per cent CP and 60 per cent TDN on DM basis up to 15 months of age and attaining 300 to 350 kg weight
(Dahiya et al., 2001). DM intake should remain around 3.0 kg per 100 kg body weight as overfeeding may lead to fat deposition and obesity in bulls which reduces libido and vigor. Increase of fat thickness in buffalo males has also been associated with accumulation of fat in the scrotal region which causes an imbalance of temperatures exchange and reduction in the semen quality mainly sperm motility and normal morphology in the ejaculates (Vale, 1994a, 1997). The feeding standards (Kearl, 1982; Mandal et al., 2003) and the most recent feeding standard (Paul and Lall, 2010) are based on NRC feeding standards and can be referred for computation of the rations for growing animals.

Supplemental feeding

Although there are few studies establishing the minimum nutritional requirements for reproducing buffalo male, nutritional deficiency in vitamins, macro and micro minerals have also been associated with reduction in semen quality. Vitamin A and E are directly involved with the quality of semen in all domestic species. Deficiency of selenium a micro mineral has been associated with an increase in sperm tail abnormalities in several species. Supplementation diets with Vit. E or selenium and combination of two resulted in improvement of semen characteristics and acrosomal morphology (Gokcen et al., 1990). The role of minerals and vitamins in reproduction is very important for seminal aspects. Many authors have related Cu, Fe, I, Mn, Mo, Se and Zn as seven gold minerals of reproduction. Acute under nutrition and specific nutrient deficiencies i.e. vitamin A, manganese, copper, protein or change in Ca++/P+ ratio adversely affect the fertility of both young and mature bulls. However, proper maintenance under optimum nutritional condition rarely produced these symptoms. Zn is involved in more than 300 enzymatic reactions and most of them are related to reproduction functions as much in male as in female. In buffalo Zn function is related to the sperm motility and may affect the sperm metabolism (Ahmed and Tohamy, 1997). Significant improvement in semen quality was noticed in mature breeding buffalo bulls given vitmin AD₃ and E injection and water splashing at the hotter part of the day in summer season (Singh et al., 2000). Attempts have been made to find out the effect of feeding some protected nutrients on growth and semen quality of the bulls. It has been suggested that protection of critical amino acids such as methionine helps to improve the production performance. Bines et al. (1980) suggested methionine cause the changes in the contents of various hormones (e.g. insulin, thyroxin) in the blood, shifts in the balance of anabolic and catabolic metabolism. Dietary protein sources that are considered to be good sources of “bypass” or rumen undegradable intake protein (UIP) have also been used in the diet of growing buffalo bulls. (Dahiya et al., 2001). A study conducted by Singh et al. (2000) found that the effect of supplementation of methionine and lysine in the feed of buffalo bulls had brought about significant (P<0.01) improvement in quality (ejaculate volume, mass activity, live sperm, total sperm per ejaculate etc.) and freezability (pre and post freezing sperm motility and morphology) of buffalo bull semen. Studies have been conducted in our laboratory to find out the effect of feeding of cotton seed cake (CSC), mustard cake and fish meal (MCFM) as sources of rumen undegradable protein and ground nut cake (GNC) to young buffalo bulls on body growth, sexual maturity and semen production. Perusal of data presented in Table-2 showed the supremacy of cotton
seed cake over the ground nut cake as protein source in the ration of the breeding bulls. It was also observed that bulls fed CSC and MCFM started exhibiting sexual behavior by mounting each other around at the age of 27-28 months, which also corresponded to the testosterone level in bulls of these groups.

2. Ameliorating heat stress

The adverse effect of heat stress can be reduced either by modifying the environment or by enhancing the adaptive capacity of animals. Efforts should be made to create better micro environment around the animal and standardize the shelters. The will include the provision of environmental control devices (misters/foggers or sprinklers during peak period of heat stress), increased roof height and provision of shade in open paddocks to protect from radiation effect. The heat stress effect can be reduced by providing good quality green forage during summer and the diet must be made more energy dense to provide sufficient energy. Minimize high fibre diets like straws and stovers by decreasing dry forages in the diet. The feeding of antioxidants (Zn, Se, Vit. E) during summer can also improve health and fertility of the bull. The increase in feeding frequency and that too in cool hours improves feed intake and production under heat stress. Water intake is closely related to dry matter intake by reducing body temperature through absorbed heat energy.

3. Improved Management practices

The maintenance of bulls in good condition is an essential requirement for successful breeding programme. A bull should be kept in an individual pen of rough concrete floor of about 40-50 sq. m with adequate loafing area of about 80 sq. m area with katcha floor, manger and water trough with access to continuous water supply. Provision of trees and land scaping around bull shed should be given priority to protect the bull from exposure to direct sun. Adequate light and ventilation arrangements are desirable for a bull shed. Semen quality (Venkatareddy et al., 1991) is adversely affected by vaccinations against FMD, HS and BQ. To certain extent this adverse effects can also be reduced by immuno-modulators. Therefore, it is advised that vaccination schedule may be followed when the season is unfavorable as during that time the semen production is usually of poor quality especially for purpose of freezing. The following measures are also necessary for proper management of breeding bulls.

- The breeding bull must be selected with true to the breed characters and should come from parents with high index of production.
- A bull should be free from communicable diseases.
- A bull should not be allowed to put on fat and should be subjected to regular exercise to maintain vigor and libido.
- Always handle a bull in firm manner and never trust him as bulls have an unpredictable viciousness
- The preputial washing prior to the semen collection is an important aspect as most of the microbial contaminations in the semen come from the preputial area.

CONCLUSIONS

An ever increasing amount of knowledge on the basic physiological mechanisms underlying the reproductive function of buffalo bulls is piling up. This
will lead to an improvement and a better refinement of protocols aimed at the control of semen production efficiency and its quality. There is a big gap on the information on the effect of minerals and vitamins supplements in the male buffalo reproduction. In the near future new approaches for molecular understanding the role of the vitamins and some minerals in the processes of spermatogenesis and sperm preservation will be very necessary. For maximizing quality germplasm production the critical control points need to be focused are: avoidance of overfeeding as it leads to excessive fattening which lowers the libido, good management and exercise of bull be regularized, provision of good quality of energy and protein sources, provision of Vitamin A and E along with minerals especially Calcium, Phosphorus and Manganese during all ages of bull.

REFERENCES
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Table 1. Age, body weight at first ejaculation, growth and seminal attributes of different groups.

<table>
<thead>
<tr>
<th></th>
<th>G-I (CSC)</th>
<th>G-II (MCFM)</th>
<th>Control (GNC)</th>
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<tbody>
<tr>
<td>Growth Rate (g/day)</td>
<td>480.00</td>
<td>444.00</td>
<td>400.00</td>
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<tr>
<td><strong>Age and body weight at first ejaculation</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>B.wt. (kg)</td>
<td>436.00</td>
<td>421.00</td>
<td>401.75</td>
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<tr>
<td>Age (months)</td>
<td>31.60</td>
<td>33.60</td>
<td>32.75</td>
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<tr>
<td><strong>Testosterone levels (mg/ml)</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>15 month</td>
<td>0.394</td>
<td>0.416</td>
<td>0.315</td>
</tr>
<tr>
<td>24 month</td>
<td>0.597</td>
<td>0.780</td>
<td>0.410</td>
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<tr>
<td>28 month</td>
<td>0.822</td>
<td>0.770</td>
<td>0.512</td>
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<td><strong>Seminal Attributes</strong></td>
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<tr>
<td>Volume/ ejaculate (ml)</td>
<td>2.13</td>
<td>0.75</td>
<td>1.07</td>
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<tr>
<td>Mass activity</td>
<td>1.01</td>
<td>0.22</td>
<td>0.15</td>
</tr>
<tr>
<td>Sperm concentration (million/ml)</td>
<td>1181.75</td>
<td>352.00</td>
<td>324.00</td>
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