Comparison of commercial semen performance following artificial insemination in cows

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Roll No. 0120/01

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A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Science in Theriogenology

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DEDICATED

TO

ALL FARMERS

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ABBREVIATIONS

AI	Artificial Insemination
ACI	Advanced Chemical Industries
ADL	American Dairy Limited
BBS	Bangladesh Bureau of Statistics
BCS	Body Condition Score
BRAC	Bangladesh Rural Advancement Committee
BLRI	Bangladesh Livestock Research Institute
CCBS	Central Cattle Breeding Station
DLS	Department of Livestock Services
FAO	Food and Agricultural Organization
HF	Holstein-Friesian
IAEA	International Atomic Energy Agency
LAL	Lal Teer Limited
NCD	Neonatal Calf Diarrhea
NGO	Non-Government Organizations
NLDP	National Livestock Development Program
OIE	Office Des International Epizootics
PRAN	Program for Rural Advancement Nationally
RCC	Red Chittagong Cattle
USDA	United States Department of Agriculture
Kg.	Kilogram
Wt.	Weight
%	Percentage
>	Greater than
<	Lesser than
♂	Male
♀	Female

Abstract

One of the essential elements in achieving high conception rate in dairy cow is good semen quality. This study was conducted to compare the performance of commercial semen following artificial insemination (AI) in cows. For this purpose a total of 170 individual cross bred cows and their progeny data were recorded randomly from five selected regions of Chattogram using a structured questionnaire. The features in this study were determined using a basic descriptive test for identifying general characteristics, correlation to find the relationship between independent variables (birth weight, sex, congenital abnormalities, respiratory distress, navel infection, calf scour in progenies) with a $p \leq 0.5$. The incidence of congenital abnormalities was significantly associated with both semen sources (P=0.03) and it was 83.33% in semen source A and 16.67% in semen source B. Respiratory distress in progenies were positively correlated (P=0.01) with semen source B, especially those were born from 87.5% and 100% blood (33.33%). Birth weight (P=0.06) and sex (P=0.68) of newborn calves was not significantly associated with any semen source. However, age of cows was responsible for congenital abnormalities in progenies (P=0.03) and it was prone to calves born from more than 5 year old cows. No significant variation were found in progeny performance with primiparous or multiparous cows. Cows with BCS 3 or 4 showed statistically significant value (P=0.04) with respiratory distress in newborn calves. Effect of vaccination in pregnant cow on calf scour was significantly (P=0.01) associated.

Key words: Commercial semen, Artificial insemination, Progeny performance.

Chapter 1: Introduction

Bangladesh is a small country with its huge population. As per Bangladesh Census Report 2022, at present a total of 165 million people are living in Bangladesh. According to BBS report 2022, the national milk demand of this huge population is 156.68 Lakh Metric Ton (250 ml/day/head) but the current milk production is 130.74 Lakh Metric Ton. Therefore, livestock especially dairy cattle improvement is essential as the current milk and meat production is not enough to fulfill the national protein demand. This deficit is due to low productive indigenous cattle though we have huge cattle (247 lakh) population in Bangladesh (DLS, 2022). Additionally, lack of monitoring of breeding policy (Khan et al., 2009), and poor semen quality (Alam and Amin, 2007) are also hindering the national progress of dairy cow development. Recognizing this fact, the government has revised its policy and has given equal priority to both public and private sectors to overcome these problems through different activities such as to disseminate the genetic merit of pure breeding bulls though frozen semen for local cattle improvement (Khalequ et al., 2012).

Artificial insemination and selection of best semen to perform AI is considered as a significant vehicle to improve the existing reproductive performance of local cattle breeds (Uddin et al., 2010). The first verifiable AI is credited to Lazzaro Spallanzani (Spallanzani, 1780) but pioneering efforts to establish AI in cattle were begun in Russia in 1899 by Ivanow (Ivanoff, 1922). In Bangladesh, AI was first introduced in 1958 during the then East Pakistan period for cattle development (Shamsuddin et al., 1987). The DLS started AI for dairy cattle improvement in 1960s by using liquid semen of high yielding variety cattle. Actually, sperm freezing dates back to 18th century in Italy when it was observed that sperm cooled by snow become motionless. An American pioneer in sperm freezing process, Dr. Jerome K. Sherman, introduced a simple technique of sperm preservation with glycerol and solid carbon dioxide in 1953. However, deep frozen semen started to be processed worldwide at late 1970s. The extension as well as commercialization of AI services started in 1985 (Ali, 2003) but most commercial companies started AI services after 2000. A 2014-15 comparative study conducted by Rahman et al. (2019) showed that, the conception rate of govt. semen was 63% and BRAC semen was 83%. The calves production rate of govt. semen was 58.49% and BRAC semen was 76% in his study. AI with frozen semen enables the use of bulls that are not well adapted to the local environment, reduce transmission of venereal diseases (Vishwanath, 2003), and accelerate genetic gains (Baruselli et al., 2017). Islam et al. (2018) revealed that the conception rate following AI was highest from Holstein Friesian semen (64%) followed by Brahman crossbred (59%) and lowest in Red Chittagong (53%) semen. The goal of the AI is to maximize the number of viable offspring per breeding animal per unit time. This can be achieved by inseminating cows with sufficient motile spermatozoa from a given ejaculate (Brinsko and Varner, 1993); therefore the main avenue for genetic improvement is the production and preservation (liquid or frozen form) of best semen from elite bull (Lobago, 2006).

Progeny test systems helps to identify elite bulls (Robertson and Rendel, 1950) and also allow to have the information of poor semen (Kumaresan, 2001). Hickson (2015) reported that birth weight of calves were affected by semen and mean birth weight was 36.1, 31.7 and 27.6 kg for Holstein Friesian calves, Holstein Friesian-Jersey calves and Jersey calves, respectively. Maltecca et al. (2006) found no significant differences for respiratory problems between calves from crossbred sires and Holstein sires. Dhakal et al. (2013) reported that male calves weighed more than female calves. However, through personal communication we were able to know that many calves born underweight or born with congenital deformities or suffered from infections like neonatal diarrhea or respiratory illness in different farms. A number of risk factors may be responsible behind this such as sire or dam effects, microorganism, environment, unhygienic condition etc. Findings of present study could be helpful in this context to guide the farmers in choosing suitable semen to breed their cows. Outcome of this study will also guide researchers and policymakers in selection of quality semen for getting better progeny. In considering the above situations the research work has been conducted with the following objectives:

- To evaluate the effect of different semen sources on the birth weight of calves
- To calculate the comparative effects of different semen on abnormalities in newborn calves
- To explore the effect of semen on male-female ratio in progenies

Chapter 2: Literature review

2.1. Definition and history of AI

Artificial insemination is a process by which semen are collected from the male, processed, stored and artificially introduced into the estrous female reproductive tract for the purpose of conception (Temesgen et al., 2017). The first successful insemination was performed by Lazzaro Spallanzani (1780) in a dog which whelped three pups 62 days later. And over 100 years later, in 1899, Ivanoff of Russia pioneered AI research in most of the animals, and successfully introduced AI in cattle for the first time (Ivanoff et al., 1922). In 1936, the first commercial AI cooperative was established in Denmark by a Dan, Sorenson (Foote, 2002). Mass breeding of cows via AI was first accomplished in Russia where 19,800 cows were bred (Webb et al., 2003). By 1960, more than 2 million cows were inseminated yearly, which was about 80% of the maximum level that AI would reach (Brassley et al., 2007). During the past 80 years, approximately 130 million inseminations has done internationally per year (Vishwanath et al., 2003).

2.1.1. AI over natural service

Having multiple benefits of AI over natural mating, it is getting popularity all over the world. It provides the opportunity to spread the superior germplasm, limit spreading of sexually transmitted diseases (Thibier and Guerin, 2000; IAEA, 2005), and produce more offspring than natural mating (Salisbury et al., 1978). Study by Fricke and Paul, (1997) revealed that pregnancy rate is 3-5% faster in AI than natural service. The opportunity to evaluate semen production and its characteristics helps to combat male infertility in AI (Chatikobo et al., 2009). AI helps in better record keeping, eliminate the costs and dangers of maintaining breeding bulls on the farm. Through AI, semen of a desired sire can be used even after death of that particular sire. Old, heavy and injured sires can be used easily (Johnson, 2011). It means that farming using AI can be more profitable apart from covering the extra costs even with calving interval of 13.5-14 months (Valergakis et al, 2007).

2.1.2. Major factors associated with success of AI

Accuracy of heat detection (Roelofs et al., 2006), satisfactory method of insemination (Paufler, 1974), site of semen deposition (O' connor et al., 2003), inseminations carried out before ovulation (Mekonen et al., 2010), highly trained inseminator (Senger and

Peters et al., 1984), proper insemination dose (Arthur, 2001) are essential for obtaining high fertilization rates. Nutritional imbalances (Grummer et al., 2004), venereal infections (Roberts, 1971), hypocalcemia, acidosis, or subclinical diseases (Gilbert et al., 2005), metritis, cysts, dystocia, and stillbirth (Maizon et al., 2004) are the important causes of diminished fertility in cattle. High temperature and humidity (Gwazdauskas and Thatcher et al., 1975), fluctuation in season (Haugan et al., 2005), aging of cows (Van Dieten, 1968), condition of stalls (De Kruif, 1975b), size of the herd, inadequate hygiene (Pelissier, 1976) will result in 5-10% lower conception rates. Fertilization rate also vary with semen quality (Olds, 1969), mishandling of semen (Saacke, 2008), thawing temperature and methods (Milad, 2011).

2.1.3. AI Techniques

The earliest method for AI in livestock was to deposit semen in vagina as like as natural service (Perry et al., 1945). The speculum method was developed next; this involved viewing the cervical os with a light source and shallowly inseminating the low dose sperm into the cervix. Even though the vaginal deposition and speculum methods were relatively easy to perform, neither were very efficient (Olds et al., 1978). The success of AI was transformed by the development of the recto-vaginal method by Danish veterinarians around 1937, which remains the method of AI still practiced today (Lopez-Gatius et al., 2000). With this method, a gloved hand in the rectum holds the cervix and guides the insemination gun through the cervix. From different studies, Schams et al. (1977) found that the best time for insemination in the cow is 12 to 20 hours after the first observation (onset) of estrus, with good results up to 6 hours after estrus. However, it is now widely used as a most valuable breeding practice available to the cattle producer (Bearden et al., 2004).

2.1.4. Disadvantages of AI

Despite the well-known advantages of AI, a large number of dairy farmers all over the world use natural service to breed their cows due to higher AI costs (Valergakis et al., 2007). The availability of liquid nitrogen for the cryopreservation of semen is a particular constraint to utilize AI as a whole (FAO, 2010). Other disadvantages of AI include poor conception rates and lengthy calving interval due to poor heat detection, and low efficiency of AI technicians (GebreMedhin et al., 2005). High cost of collection, processing, storage and transport of semen as well as budget and administrative problems is also another disadvantage of AI (Desalegn et al., 2008). AI decreases the value of pure stock (Shehu et al., 2010). AI requires specialized knowledge, trained individuals, and the time required to properly execute an effective AI program is considerably more than with natural service (Thomas et al., 2011).

2.2. National breeding policy and practices

The basic aim of cattle breeding program in Bangladesh is to improve the genetic potentiality of local cattle through infusion of exotic gene (Ahmed and Islam et al., 1987). The breeding strategy of Bangladesh has focused mainly on biological rather than economic evaluation. DLS and Central Cattle Breeding Station (CCBS) mainly control cattle breeding throughout the country (Bhuiyan et al., 2015), and they maintain different genotypes such as Holstein, Jersey, Sahiwal, Red-Sindhi, Local, Holstein-Friesian crosses, Jersey crosses and Sahiwal crosses. In addition, there are some Non-government organizations (NGOs) and commercial companies who has own cattle breeding station from where they produce semen and distribute throughout the country. The existing breeding programme, as adopted from 1982, was (i) breed females in urban, semi-urban and milk pocket areas with 50% Friesian and 50% Sahiwal / indigenous bulls and (ii) breed females in rural areas with 50% Friesian and 50% indigenous bulls (Bhuiyan, 1997). However, some commercial farms used 100 % Friesian bulls.

Table 2.1: Current livestock breeding policy of Bangladesh

Species	Purpose	Production system	Breeding strategy	Mating plan
Cattle	Milk	High-input/ Intensive	Up-grading	Top most up-graded HF ♀ x pure (100%) HF ♂
		Medium/Semi-intensive	Up-grading/ purebreeding	50% IC ♀ x 50% HF ♂, IC ♀ x 50% HF ♂, SL♀ x SL♂ and IC ♀ x SL♂
		Low-input/ Subsistence	Selective-breeding	SL, PC, RCC, MUC and other improved IC
Cattle	Meat	Medium-input	Up-grading	50% IC ♀ x 50% BR ♂ or up-graded males of HF and SL

Source: NLDP, 2007; Bhuiyan, 2014. (HF = Holstein-Friesian; BR = Brahman cattle; SL = Sahiwal; PC = Pabna cattle; RCC = Red Chittagong cattle; MUC = Munshiganj cattle, & IC = Indigenous cattle).

2.2.1. Types of semen used in AI

In most of the developing countries, AI was introduced on a small scale during the 1950s and 1960s and was carried out with fresh or room-temperature semen (Vishwanath and Shannon, 2000). During the late 1970s deep-frozen semen started to be processed in different countries while donor agencies encouraged the introduction of highly specialized and costly AI establishments, supported by international investment.

2.2.2. Performance of different crossbreds

The productive and reproductive performances of different crossbreds have been studied by several researchers and they showed that Holstein-Friesian combinations are better (Cunningham and Syrstad, 1987) for both productive and reproductive traits than the other breed combinations. However, in tropical environment, low survivability of temperate breeds has been reported relative to crosses involving tropical breeds like Sahiwal and Red-Shindhi with local cattle (McDowell, 1985).

Table 2.2: Reproductive performance of different cattle breeds in Bangladesh

Traits	**Genetic group**							
	L	**Pab**	**S**	**HF**	**S × L**	**S×Pab**	**RS× L**	**HF× L**
Birth weight (kg)	14-16	20	20	27	18	21	16	21
Age at sexual maturity (days)	1140	687	1080	659	1059	1118-1156	1057	920
Calving interval (days)	484	450	502	493	479	-	486	470
Gestation period (days)	279	283-286	279	283	280	285	280	280
Service per conception	1.76	1.20-1.29	1.90	1.27	-	1.08	-	-

L=Local Bangladeshi, S = Sahiwal, RS= Red Shindhi, HF= Holstein Friesian, and Pab = Pabna cattle.

Source: Islam et al., 2004; Hossain et al., 2002; Khan et al., 2000; Khan and Khatun,1998; Majid et al., 1998; Bhuiyan et al., 1998; Nahar et al., 1992; Ahmed and Islam et al., 1987.

2.2.3. Semen quality of different sire breed

It was observed in the study of Hossain et al. (2012), the maximum average sperm concentration was obtained from Sahiwal (1858.4 million/ml) than Friesian and native sire. The lowest average sperm concentration was obtained from LF_1×F (Local ×Friesian × Friesian) and the mean value was 1286.6 million/ml. He also observed that maximum average motility was obtained from Sahiwal sire and the mean value was 68.8%. However, the minimum average motility was obtained from L×F (Local ×Friesian) and the mean value was 63.7%.

Nasrin et al. (2008) studied that the highest sperm concentration and highest live sperm percentage was found in Holstein breeding bull (1028 ± 41.55 $\times 10^6$/ml and 87%, respectively) and lowest sperm concentration and lowest live sperm was found in RCC breeding bull (739 ± 10.56 $\times 10^6$/ml and 78%, respectively). Similar findings was also found in the study of Rao (1979) and Hafez (1993). Al-Hakim et al. (1984) and Hahn et al. (1969) observed the average live sperm percentage for Holstein bull was 83.5%. Al-Hakim et al. (1984) revealed that highest percentage of normal sperm was found in Holstein cross (90%) sire followed by Sindhi and Sahiwal cross sire and Red Chittagong sire had lowest percentage (82%) compared to other bulls of his study. Hahn et al. (1969) obtained average normal spermatozoa percentage to be 85% in Holstein semen.

The mean percentage of abnormal sperm in semen from dairy sires was 7.19% ± 4.91% and from beef sires was 15.83% ± 9.28% in the study of Ghirardosi et al. (2018). Individual motility of Friesian sire did not differ among seasons but in Jersey sire it was lower (68%) during wet summer (July-October) than other seasons (70-72%) found in the study of Fiaz et al. (2010). The mass motility of semen in both breeds was significantly lower during wet summer. Wet summer also resulted in reduced number of semen doses frozen per bull in both breeds in his study.

Hossain et al. (2022) conducted a study to compare the semen quality of native cattle sire and found that total motility was higher in Munshiganj bull and static motility was higher in BLRI cattle breed 1 (BCB1) bull. The highest sperm concentration was found in Munshiganj sire (1669.60 ± 192.07 million/ml) followed by RCC (1648.70 ± 91.07 million/ml) and BCB1 sire (1481.60 ± 167.35 million/ml). Moreover, the highest sperm morphological abnormalities (9%) were observed in BCB1 followed by Munshiganj and RCC breeding bull. In his study highest fertility rate was found for RCC (63%) than BCB1 and Munshigang sire.

2.2.4. Bull semen producer and importer commercial companies

Artificial insemination program has been operated by DLS, as a pioneer since the inception of upgrading scheme. Later on, one dairy cooperative society (Bangladesh Milk Producers Cooperative Society, brand name Milk Vita) and few private companies like ACI, BRAC, ADL, Lal Teer Livestock (LTL) Development, Ejab Alliance Limited, PRAN, Gentech International have started their AI activities (Humayon kabir et al., 2018) using imported pure breeds as well as locally produced superior Local-Friesian, Local-Sahiwal and Sahiwal-RCC breeding bulls. Bangladesh has started importing semen in 1964 from several approved countries and is the largest importer of semen in the world. As per Volza's Bangladesh import data (Aug 26, 2022), Bangladesh imports most of its semen from India, Germany and United States, and also import from Canada, and several European countries like France, Netherlands, Italy etc. Therefore, a considerable number of crossbred cattle with high genetic merit are discernible nowadays throughout the country.

2.2.5. Performance of commercial semen

Bhuiyan and Shamsuddin (1999) made a comparison between quality of imported and native frozen semen in AI programs and reported that imported semen possessed better post-thaw sperm motility (60% vs. 45%), more motile spermatozoa/ cow dose (14.7×10^6 vs. 9.9×10^6), and higher proportion of spermatozoa with normal acrosome, mid-piece and tail (83% vs. 61.4%) than that of native semen. Imported semen yielded high first service conception rate (59.9%) than did native semen (52.9%).

Humayon kabir et al. (2018) conducted a study on abnormalities (bent tail, coiled tail, distal droplet %, and proximal droplet % of total) of different commercial semen like BRAC, MILK VITA, ACI and PRAN. The highest (22.86±3.22) abnormalities were in PRAN Company semen and lowest (13.24±1.80) were for ACI semen. He found highest bent tail abnormalities, and highest proximal & distal droplet percentage of total (11.80±4.81, 5.34±2.74 and 12.86±9.35, respectively) in PRAN semen and lower coiled tail abnormalities, and lower proximal & distal droplet percentage of total (0.94±0.45, 2.02±1.16 and 6.00±2.23, respectively) in ACI semen.

Mehedi Hasan et al. (2020) conducted a research to compare the quality of 100% pure Holstein Friesian and Sahiwal semen imported by American dairy limited (ADL). He found that Progressive motility was highest in imported pure Holstein Friesian semen (68.19%) than that of Sahiwal semen (56.54%). Percentages of immotile spermatozoa in the imported pure semen of Sahiwal bull (30.45%) was highest than that of Holstein Friesian (26.76%) in his study. Bhupal et al. (1993) reported that in identical environment, HF semen had better post freezing motility than that of Sahiwal semen.

Tohura et al. (2018) conducted a study on bull semen quality at breeding bull station of Ejab Alliance Limited and found that all the quality of Sahiwal semen was significantly higher than Holstein-Friesian semen. She reported that the average sperm motility and average sperm normal morphology was significantly higher in Sahiwal (77.4% and 85.1%, respectively) than in Holstein-Friesian (73.1% and 82.4%, respectively). Rahman et al. (2014) observed highest mass activity in Holstein-Friesian semen and lowest in Red Chittagong Bull semen. Buhr et al. (1993) found that mass activity of spermatozoa was higher in Sahiwal semen (3.4%) than in Holstein-Friesian (2.8%).

Comparisons of results with sexed commercial semen and normal conventional semen in research settings indicate a difference in pregnancy rates between 10% and 15% (Seidel, 1998). Conception rates for Danish Holsteins are approximately 12% lower for sexed commercial semen than for conventional semen. Jerseys had a slightly lower conception rate with sexed semen compared to Holsteins in the study of Borcheresen and Peacock (2009). The highest conception rates (61%) were among the Red Danish Dairy Bull semen, and this breed demonstrated the least difference (5%) between sexed and conventional semen. The sex ratio for conventional semen is very close to 50% as is normal for commercially sold semen.

2.2.6. Factors related to semen quality

Many properties of the semen (spermatozoa) are important for successful fertilization. Stalhammar et al. (1989) observed the highest sperm concentration and highest total number of spermatozoa during summer, while Mathevon et al. (1998) found higher values during winter and spring. Optimal ambient temperature for semen production was found to be approximately 15–20℃ (Parkinson, 1987). Varying quality of feed may affect semen quality up to several weeks (Peter, 1991). A previous experiment reported that qualities of semen were affected by breeds (Al-Hakim et al., 1986) and age of bull (Brito et al., 2002a). Murphy et al. (2013) reported that larger sperm numbers per AI dose had an impairing effect on the viability of sperm cells. Mathevon et al. (1998) observed a significant effect of the semen handler and collection team on ejaculate volume and total number of spermatozoa while no significant effect was found on sperm concentration and motility. Everett and Bean et al. (1982) found that increase or decrease collection interval and frequency of collection badly affect semen quality. Consequences of freezing/thawing are also very important to obtain semen with high fertilizing capacity (Curry, 2000).

2.3. Effect of sire on progeny performance

2.3.1. Effect of sire on birth weight of progeny

Birth weight of calves differed between breeds and sire within breed groups. The direct genetic effects of sire on calf birth weight were highly significant in the study of Olson et al. (2009) who revealed that calves with 100% Holstein genes were expected to weigh 14.3 kg more than calves with 100% Jersey genes. No effects of maternal gene on calf birth weights was found in his study. Anderson and Plum (1965) reported that the average birth weight of Sindhi sired calves was 19.1 kg, while Charolais sired calves was 48 kg at birth. In a study of Coleman et al. (2021) it was found that mean birth weight of the Angus sired calves was 36 kg, similar to the value of 36.1 for the Hereford sired calves. The average birth weights of the Angus and Brahman sired calves were 26.3 and 25.8 kg, respectively in the study of Reynolds (1980). Ellis et al. (1965) reported similar findings for crosses of the Brahman sired calves. Abdel et al. (1991) found in their study on Butana and Friesian×Kenana crosses that sire had highly significant effect on birth weight of calves. Finding of Adeneye (1982) in Sudan showed significant effect of sire on birth weight of Kenana calves, but dam effect was not significant in his study. Eler et al. (1990) and Avila et al. (1990) reported significant effect of sire on Limousine and Nellore calves in Argentina and Brazil, respectively. Rico et al. (1987) found a significant effect of sire on Charladies and Africander sired calves in Cuba and South Africa, respectively.

2.3.2. Effect of sire on congenital abnormalities in progeny

The number of congenitally abnormal calves was highest for Jersey bull semen (4.8%) and no abnormalities was found for Holstein and Red Sindhi calves in the study of

Borcheresen and Peacock (2009). He also reported that the number of dead calves in the first 24 h after birth were comparatively high in Jersey bull semen (1%) compared to Holstein (0.4%) and Red Sindhi (0.7%) semen. Runnells and associates (1965) indicated that cleft palate is common in calves. Cleft palate in calves may occur singly, but in Charolais and Hereford sired calves, it was seen with other inherited syndrome (Rousseaux, 1994). Schistosomus reflexus occurs in all ruminant, mostly in cattle, but occasionally in sheep and goats (Craig, 1941). In the study of Robert et al. (1996), among the beef breeds affected, 55.6% were found in Hereford sired calves and 44.4% in Angus sired calves.

2.3.3. Effect of sire on sex of progeny

Differences between sexes appear to be relatively constant across different sire of cattle (Burris and Blunn, 1952). Borcheresen and Peacock (2009) found that the sex ratio was close to 90% female for all sire breeds in his study but numerically greater for Jerseys. Most researchers revealed that sex of calves most likely is the earliest recognized factor influencing birth weight. Researchers noted that male calves had approximately 5 to 8% higher birth weight over the female calves (Eckles, 1919). Male calves recorded insignificantly higher birth weight (25.26 kg) compared with female calves (24.91 kg) reported by Ibrahim et al. (2015). A similar result was reported in Sudan by Khallfalla (1977) who revealed that sex of calf showed highly significant effect on birth weight of Kenana calves.

2.3.4. Effect of sire on infection in calves

In a study of Jersey × Holstein crossbreeds in the United States, Maltecca et al. (2006) reported that 33% of the calves had some degree of respiratory disease during the first 7 d after birth. April had the lowest and October had the greatest effect on liability to respiratory disease. Calves born in spring and early summer (March to June) tended to have a lower tendency to respiratory disease than calves born during the winter (October to February). He also found that AI with Jersey breed semen leads to an improvement in calf health and survival relative to performance in purebred Holstein semen. The percentage of calf scour or neonatal diarrhea in calves during the study of Meganck et al. (2014) was significantly lower in the treated parent herds (14.3%) compared to the control parent herds (39.7%).

2.4. AI/ Semen borne diseases

The main goal for AI is to achieve genetic improvement. However, transmission of infectious diseases by semen constitutes a risk which must be avoided. Semen used for AI must therefore be free of infectious agents.

Table 2.3: Concise description of AI/ semen borne diseases in OIE lists A and B

Disease	List OIE	Incubation period	Viraemia/ Period of transmission	Transmission by semen/ AI[a]
FMD	A	2-8 days	<14 days (acute phase) or up to 2 years (chronic carriers)	++
IBR/IVP	B	2-5 days	2-20 days	++
BVD	-	2-15 days	2-15 (56) days	++
Genital Camphylobacteriosis	B	<3 days	Lifelong infection	++
Genital Trichomoniasis	B	<3 days	Do	++
Bovine brucellosis	B	14-120 days	Prolonged periods after infection	+
Leptospira hardjo	B	<7 days	Prolonged periods after infection	+
Bovine tuberculosis	B	>3 weeks	During lifetime after infection	+
CBPP	-	2-6 weeks	Do	+
Haemophilus somnus	-	-	Do	+

++, easily; +, possible

Source: OIE, 1996; Meyer, 2017; Newcomer, 2014; Givens, 2009; Borel, 2007.

Other organisms which might be transmitted via semen and may cause infertility are Coxiella burnetii (Wentink et al., 2000), Chlamydiaceae (Teankum et al., 2007), Lumpy skin disease virus (Annandale et al., 2014), Bovine leukemia virus (Wrathall et al.,

2006) and Bluetongue virus (Vanbinst et al., 2010). The possibility of venereal transmission of Neospora caninum is very low to non-existent (Ferre et al., 2008).

2. 5. Common neonatal problems

Atresia ani is the failure of the anal membrane to break down to make an anal orifice. It has been reported as most frequently encountered surgical affection in newborn calves (Samad, 2008). Calf scour or neonatal calf diarrhea is the most commonly reported calf disease and the major cause of neonatal mortality (Wells and Garber et al., 1996). This incidence is reported to vary between 0 and 70 % among herds throughout the world (Bcndali and Bichct et al., 1999). The prevention of neonatal diarrhea in calves is difficult owing to the large number of etiological agents like *Escherichia coli*, rotavirus, coronavirus and cryptosporidium mainly. Factors involved in calf scour could be at two levels: herd and calf level (Desjouis and Millet et al., 1989). Morbidity arising from respiratory dystress high in calves kept in overcrowding space than for calves with sufficient space (Fourichon and Seegers et al., 1996).

Chapter 3: Materials and Method

3.1. Study location and duration

The study was carried out at five upazilas of Chattogram district, which is one of the most important dairy zones of Bangladesh (Fig 3.1). Active surveillance system was used to collect data from the selected farms and data were collected over a period of June’2022 to August’2022.

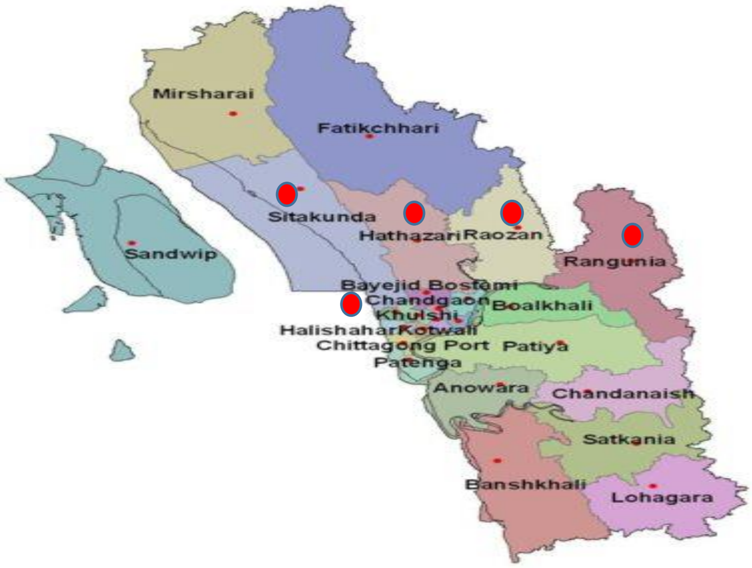


Fig 3.1: Study area (Chattogram district) with selected regions

3.2. Study population and design

During the study period, a total of 170 individual cows of different dairy farms (N=27) were selected randomly as study population. The studied cows were being artificially inseminated by 5 different sources of commercial semen. Source of semen, breed with blood percentage, cow’s physiological and reproductive records, newborn or progeny data were taken through farmer’s interviews and from farm registered books. Collected data were subjected to statistical analysis and were defined separately.

3.3. Recording of data

A pre-tested questionnaire was prepared and used for conducting face-to-face interviews for this study. The questionnaire was designed to cover 3 broad areas of information such as i) information related to the semen and provision of AI services, ii) cow factors related to progeny performance and iii) outcome/performance efficiency in progenies in order to compare the performance of semen across different commercial companies. Beside this farm record book was used to collect data. The questionnaire was prepared in English and then translated into Bengali for local people. Before starting the interview, the objectives of the study were described to the farmers with friendly behavior, and their verbal consent was taken consciously before their inclusion in the study. All the participants willingly gave the necessary information for this study. Data included address, date, number of breeding bull and cow in the respective farm, source of semen, date of AI, cow's breed, age, parity, body condition score (BCS), vaccination, deworming, service per conception rate, expected date of delivery, delivery nature, and abnormalities after pregnancy. Progeny data included their sex, birth weight, congenital abnormalities, respiratory distress, navel infection, calf scour and other data relevant to the study were recorded.

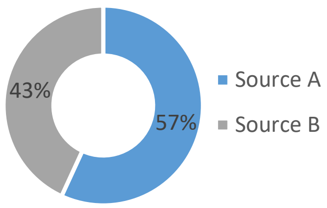
3.4. Data management and analysis

All data (170) were entered into Microsoft Excel 2010, USA. Data were cleaned, sorted, and coded in MS Excel 2010 before exporting to STATA-14 (Stata Corp, 4905, Lakeway Drive, College Station, Texas 77845, USA) for descriptive and correlation analysis. Frequency distribution of variables were presented according to categories of each selected factor (semen source, blood percentage, cow factors and progeny factors). Pearson chi test was carried out to assess association between the responsible independent variables; semen source, blood percentage and the studied progeny variables (sex, birth weight, congenital abnormalities, respiratory distress, navel infection, and calf scour). On the basis of birth weight newborn calves were categorized into four groups: 20-25 kg, 26-30 kg, 31-35 kg and 36-40 kg. Pearson chi test also fetched out to identify association between the cow factors and progeny variables. The results were expressed in frequency number, percentage, and p-value. The significant difference in the proportion of factors between different categories of independent variables was ascertained by $p \leq 0.05$.

Chapter 4: Result

4.1. Descriptive statistics of semen sources and blood percentages

Figure 4.1 represented the frequency (%) of semen source and blood percentage. Out of 170 samples, semen source A were 91 (57%) and source B were 69 (43%). There were four types of blood percentage found (75, 87.5, 93.75 and 100%). Frequency use of each types of blood percentage in the cows were as 16 (9.41%), 53 (31.18%), 7 (4.12%) and 94 (55.29%), respectively.



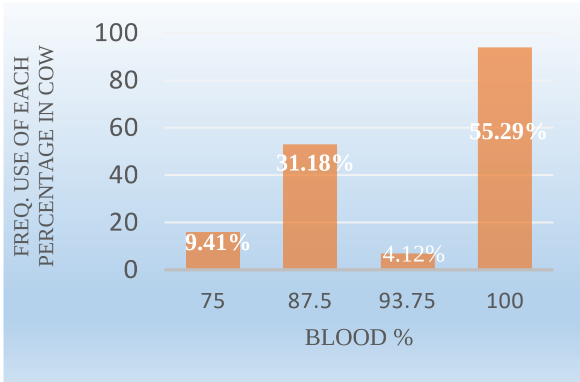


Fig 4.1: Frequency of semen sources and blood percentages

4.2. Descriptive statistics of progeny related variables

As showed in table 4.1, the mean percentage of male and female progeny were 40.59% and 59.41%, respectively. Congenital abnormalities were found in 14 (8.24%) progeny. Most of the calves 54 (36.24%) were 26-30 kg at their birth. Lowest birth weight (20-25 kg) were recorded in 24 (16.11%) progenies. Then 42 (28.19%) progenies were between 30-35 kg and 29 (19.46%) progenies were between 35-40 kg at their birth. Respiratory distress, naval infection and calf scour were positive in 21 (12.35%), 13 (7.65%) and 16 (10.67 %) progeny, respectively.

Table 4.1: Frequency of progeny variables

Traits of progeny	Frequency (%)
Sex	
Male	69 (40.59%)
Female	101(59.41%)
Congenital abnormalities	
Yes	14 (8.24%)
No	156 (91.76%)
Birth weight (kg)	
20-25	24 (16.11%)
>25-30	54 (36.24%)
>30-35	42 (28.19%)
>35-40	29 (19.46%)
Respiratory infection	
Yes	21 (12.35%)
No	149 (87.65%)
Navel infection	
Yes	13 (7.65%)
No	157 (92.35%)
Calf scour	
Yes	16 (10.67%)
No	134 (89.33%)

4.3. Distribution of cow level factors

Table 4.2 described that among 170 samples, 158 (92.94%) were Holstein-Friesian cows. According to age, the study animals were categorized into 4: 2-4 years, 4-6 years, 6-8 years and >8 years. Cows within 2-4 years of age were highest in percentage 82 (51.90%). More than 8 years old cow were lowest in percentage 6 (3.80%). Then cows within 4-6 years of age were 38 (24.05%) and within 6-8 years of age were 32 (20.25%), respectively. The number of parity in cows were categorized as 1-2, 3-5 and 6-8. Cows within 3^{rd} to 5^{th} parity were highest in percentage 83 (48.82%). First to second parity cows were 72 (42.35%) and 6^{th} to 8^{th} parity cows were 15 (8.82%), respectively.

Standard BCS was considered as 3.5 and 113 (48.82%) cows meet this criteria. Cows with BCS below 3 or BCS 4 were 39 (42.35%) and 39 (8.82%), respectively. Out of 170 cows, 134 (78.82%) were vaccinated and rest 36 (21.18%) were non-vaccinated. Deworming was completed in 159 (93.53%) cows and only 11 (6.47%) cows were not dewormed. According to service required for conception, the cows were classified into 4: 1-2, 3-4, 5-6 and 7-8. Hundred (58.82%) cows required only 1-2 service for conception. Then 57 (33.53%) cows required 3-4 service, 6 (3.53%) cows required 5-6 service, and 7 (4.12%) cows required 7-8 service, respectively. The studied animals were categorized into 3: 265 to 275 days, 276 to 285 days and 286 to 295 days, according to gestation period. It was found that most of the cows 73 (43.35%) delivered within 276-285 days. More than 285 days required in 53 (31.55%) cows to deliver the calves. 42 (25%) cows delivered their calves before 276 days. Within the sample population, 118 (69.82%) cows delivered their calves without any assistance and 51 (30.18%) cow required manual or mechanical assistance. After parturition, different types of reproductive problems were encountered in 50 (29.41%) cows, whereas no difficulties were found in 120 (70.59%) cows.

Table 4.2: Distribution of cow level variables (n=170)

Traits of cow	Frequency (%)
Breed (HF)	158 (92.94%)
Cow's age (in year)	
2-4	82 (51.90%)
4-6	38 (24.05%)
6-8	32 (20.25%)
>8	6 (3.80%)
Parity	
1-2	72 (42.35%)
3-5	83 (48.82%)
6-8	15 (8.82%)
BCS	
3	39 (42.35%)
3.5	113 (48.82%)
4	18 (8.82%)
Vaccination	
Yes	134 (78.82%)
No	36 (21.18%)
Deworming	
Yes	159 (93.53%)
No	11 (6.47%)
Service per conception rate	
1-2	100 (58.82%)
3-4	57 (33.53%)
5-6	6 (3.53%)
7-10	7 (4.12%)
Gestation period (days)	
265-275	42 (25.00%)
276-285	73 (43.35%)
286-295	53 (31.55%)
Delivery nature	
Normal	118 (69.82%)

Assisted	51 (30.18%)
Reproductive difficulties after parturition	
No	120 (70.59%)
Yes	50 (29.41%)

4.4. Correlation of semen source with progeny variables

Correlation analysis was performed to compare semen source A with semen source B and expressed in table 4.3. Among the studied variables, only congenital abnormalities was statistically significant with semen sources. The result showed that higher congenital abnormalities (n=83.33%) were found in semen source A and it was statistically significant (P=0.03). However, other progeny variables like sex, birth weight, respiratory distress, navel infection and calf scour were not statistically significant (P≤0.05) with the semen sources.

Table 4.3: Correlation between progeny variables and semen sources (SS)

Traits	SS A	SS B	P-value
Sex			
Male	34 (n=56.67%)	26 (n=43.33%)	0.68
Female	48 (n=53.33%)	42 (n=46.67%)	
Birth weight (kg)			
<30	38 (n=47.50%)	42 (n=52.50%)	0.06
>30	44 (n=62.86%)	26 (n=37.14%)	
Congenital abnormalities			
Present	10 (n=83.33%)	2 (n=16.67%)	0.03
Absent	72 (n=52.17%)	66 (n=47.83%)	
Respiratory distress			
Present	12 (n=66.67%)	6 (n=33.33%)	0.27
Absent	70 (n=53.03%)	62 (n=46.97%)	
Navel infection			
Present	7 (n=58.33%)	5 (n=41.67%)	0.79
Absent	75 (n=54.35%)	63 (n=45.65%)	
Calf scour			
Present	9 (n=56.25%)	7 (n=43.75%)	0.89
Absent	73 (n=54.48%)	61 (n=45.52%)	

4.5. Correlation of progeny variables with blood percentages of semen source A

Table 4.4 represents the association of progeny variables with blood percentages of semen source A. Among the studied progeny variables, no variables were statistically significant with the different blood percentages of semen source A.

Table 4.4: Correlation of progeny variables with different blood percentages of semen source A

Traits	Blood Percentage				
	75 %	**87.5 %**	**93.75 %**	**100 %**	**P-value**
Sex					
Male	4 (n=11.76%)	7 (n=20.59%)	0 (n=0.00%)	23 (n=67.65%)	0.06
Female	1 (n=2.08%)	14 (n=29.17%)	5 (n=10.42%)	28 (n=58.33%)	
Birth weight (kg)					
<30	1 (n=2.63%)	8 (n=21.05%)	4 (n=10.53%)	25 (n=65.79%)	0.22
>30	4 (n=9.09%)	13 (n=29.55%)	1 (n=2.27%)	26 (n=59.09%)	
Congenital abnormalities					
Present	10 (n=7.25%)	45 (n=32.61%)	5 (n=3.62%)	78 (n=56.52%)	0.74
Absent	5 (n=6.94%)	19 (n=26.39%)	4 (n=5.56%)	44 (n=61.11%)	
Respiratory distress					
Present	2 (n=16.67%)	1 (n=8.33%)	1 (n=8.33%)	8 (n=66.67%)	0.22
Absent	3 (n=4.29%)	20 (n=28.57%)	4 (n=5.71%)	43 (n=61.43%)	
Navel infection					
Present	0 (n=0.00%)	3 (n=33.33%)	0 (n=0.00%)	6 (n=66.67%)	0.68
Absent	5 (n=6.85%)	18 (n=24.66%)	5 (n=6.85%)	45 (n=61.64%)	
Calf scour					
Present	2 (n=28.57%)	1 (n=14.29%)	0 (n=0.00%)	4 (n=57.14%)	0.86
Absent	3 (n=4.00%)	20 (n=26.67%)	5 (n=6.67%)	47 (n=62.67%)	

4.6. Correlation of progeny variables with blood percentages of semen source B

Table 4.5 described the association between progeny variables and the blood percentages of semen source B. The study showed that among the studied progeny variables, only respiratory distress was found strongly significant (P=0.01) with blood percentages of semen source B. Highest percent of respiratory distress (33.33%) was encountered in progenies born from 87.5% and 100% blood.

Table 4.5: Correlation of progeny variables with blood percentage of semen source B

Traits	Blood Percentage				
	75 %	**87.5 %**	**93.75 %**	**100 %**	**P-value**
Sex					
Male	2 (n=7.69%)	10 (n=38.46%)	0 (n=0.00%)	14 (n=53.85%)	0.86
Female	4 (n=9.52%)	15 (n=35.71%)	1 (n=2.38%)	22 (n=52.38%)	
Birth weight (kg)					
<30	5 (n=12.20%)	14 (n=34.15%)	0 (n=0.00%)	22 (n=53.66%)	0.38
>30	1 (n=3.70%)	11 (n=40.74%)	1 (n=3.70%)	14 (n=51.85%)	
Congenital abnormalities					
Present	1 (n=50.00%)	0 (n=0.00%)	0 (n=0.00%)	1 (n=50.00%)	0.19
Absent	5 (n=7.58%)	25 (n=37.88%)	1 (n=1.52%)	35 (n=53.03%)	
Respiratory distress					
Present	1 (n=16.67%)	2 (n=33.33%)	1 (n=16.67%)	2 (n=33.33%)	0.01
Absent	5 (n=8.06%)	23 (n=37.10%)	0 (n=0.00%)	34 (n=54.84%)	
Navel infection					
Present	0 (n=0.00%)	1 (n=20.00%)	0 (n=0.00%)	4 (n=80.00%)	0.63
Absent	6 (n=9.52%)	24 (n=38.10%)	1 (n=1.59%)	32 (n=50.79%)	
Calf scour					
Present	1 (n=14.29%)	3 (n=42.86%)	0 (n=0.00%)	3 (n=42.86%)	0.89
Absent	5 (n=8.20%)	22 (n=36.07%)	1 (n=1.64%)	33 (n=54.10%)	

4.7. Association of cow factors with progeny performance

Table 4.6 represented the effect of cow factors on progeny variables such as birth weight, congenital abnormalities, respiratory distress, navel infection, and calf scour. Among the studied progeny variables, congenital abnormalities was statistically significant (P=0.03) with age of the cows. Highest congenital abnormalities (n=58.33%) found in progenies who were born from more than 5 years old cows. No progeny variables were significant with the parity of cows. Analysis also showed that respiratory distress in progeny was significantly correlated (P=0.04) with the BCS of dam. Respiratory distress was more prone to progenies (n=55.56%) born from cows having body condition score below 3 or above 4. Calf scour in progenies have found to be strongly significant (P=0.01) with the vaccination in cows. Highest percentage (n=62.50%) of calf scour were found in progenies born from non-vaccinated cows. Current study showed an unexpected association between congenital abnormalities (P=0.02) and calf scour (P=0.001) of progenies with deworming in dams. Analysis showed that highest congenital abnormalities (n=75.00%) and highest calf scour (n=68.75%) were found in progenies born from dewormed cows.

Table 4.6: Effect of cow factors on progeny performance

Traits	Birth wt.(kg)		Cong abn.		Res. dis.		Navel inf.		Calf scour	
	<3o	>3o	Abs.	Pres.	Abs.	Pres.	Abs.	Pres.	Abs.	Pres.
Cow's age (in year)										
2-5	52 (n=65.82%)	27 (n=34.18%)	99 (n=71.74%)	5 (n=41.67%)	94 (n=71.21%)	10 (n=55.56%)	96 (n=69.57%)	8 (n=66.67%)	96 (n=71.64%)	8 (n=50.00%)
>5	52 (n=73.24%)	19 (n=26.76%)	39 (n=28.26%)	7 (n=58.33%)	38 (n=28.79%)	8 (n=44.44%)	42 (n=30.43%)	4 (n=33.33%)	38 (n=28.36%)	8 (n=50.00%)
P-value	0.32		0.03		0.17		0.83		0.07	
Parity										
3-5	37 (n=46.84%)	32 (n=45.07%)	61 (n=44.20%)	8 (n=66.67%)	64 (n=48.48%)	5 (n=27.78%)	64 (n=46.38%)	5 (n=41.67%)	60 (n=44.78%)	9 (n=56.25%)
<3 or >5	42 (n=53.16%)	39 (n=54.33%)	77 (n=55.80%)	4 (n=33.33%)	68 (n=51.52%)	13 (n=72.22%)	74 (n=53.62%)	7 (n=58.33%)	74 (n=55.22%)	7 (n=43.75%)
P-value	0.82		0.13		0.09		0.75		0.38	
BCS										
3.5	51 (n=64.56%)	47 (n=66.20%)	93 (n=67.39%)	5 (n=41.67%)	90 (n=68.18%)	8 (n=44.44%)	89 (n=64.49%)	9 (n=75.00%)	89 (n=66.42%)	9 (n=56.25%)
3 or 4	28 (n=35.44%)	24 (n=33.80%)	45 (n=32.61%)	7 (n=58.33%)	42 (n=31.82%)	10 (n=55.56%)	49 (n=35.51%)	3 (n=25.00%)	45 (n=33.58%)	7 (n=43.75%)
P-value	0.83		0.07		0.04		0.46		0.41	
Vaccination										
No	17 (n=21.52%)	13 (n=18.31%)	26 (n=18.84%)	4 (n=33.33%)	25 (n=18.94%)	5 (n=27.78%)	26 (n=18.84%)	4 (n=33.33%)	20 (n=14.93%)	10 (n=62.50%)
Yes	62 (n=78.48%)	58 (n=81.69%)	112 (n=81.16%)	8 (n=66.67%)	107 (n=81.06%)	13 (n=72.22%)	112 (n=81.16%)	8 (n=66.67%)	114 (n=85.00%)	6 (n=37.50%)
P-value	0.62		0.22		0.37		0.22		0.01	
Deworming										
No	6 (n=7.59%)	4 (n=5.63%)	7 (n=5.07%)	3 (n=25.00%)	9 (n=6.82%)	1 (n=5.56%)	8 (n=5.80%)	2 (n=16.67%)	5 (n=3.73%)	5 (n=31.25%)
Yes	73 (n=92.41%)	67 (n=34.37%)	131 (n=94.93%)	9 (n=75.00%)	123 (n=93.18%)	17 (n=94.44%)	130 (n=94.20%)	10 (n=83.33%)	129 (n=96.27%)	11 (n=68.75%)

P-value	0.63	0.02	0.84	0.14	0.001

Chapter 5: Discussion

In tropical countries, low reproductive performance is a major problem which is associated with semen quality of the stud bull (Annual report of DAPH, 2011). Rahman et al. (2019) reported that DLS produce 60% frozen and 40% liquid semen, whereas most commercial companies produce 100% frozen semen. It was observed in this study that 83.33% congenital abnormalities were found in progenies born from semen source A and 16.67% congenital abnormalities found in progenies born from semen source B. Sire effect, blood percentage, dam effect may be the reason for higher congenital abnormalities in semen source A. Reports in the literature concerning congenital abnormalities in newborn calves are typically case reports, with practically lack of previous research where effect of semen source was observed on the congenital abnormalities in newborn progenies. Congenital abnormalities may occur from genetic, environmental, infectious, toxicological, pharmaceutical, nutritional, teratogens (Smolec et al., 2010) or due to other factors. Clinical study suggested that crossbred calves suffer from various congenital diseases and showed great susceptibility to atresia ani, may be due to defective bull semen or other conditions (Azizi et al., 2010). Das and Hashim (1996) found no gender predilection for atresia ani but Martens et al. (1995) stated most of his study calves (76%) with atresia ani were male. High incidence of ocular dermoids was observed in cross-bred calves, occurrence in males more than females and it may be transmitted genetically found in the study of Castro et al. (2006). According to Fraser et al. (1961), cleft palate was apparently hereditary in nature. Hydrocephalus occur mainly due to excessive production or defective absorption of cerebrospinal fluid; however, hereditary, infectious, and nutritional factors can also predispose this condition (Sharda and Ingole, 2002). In the study of Robert et al. (1996), 63.8% schistosomus reflexus cases were seen in Jersey breeds, 29.2% in Friesians, 4.2% in Dairy Shorthorns and 1.4% in Guernsey or Ayrshire breed.

The study also found that higher respiratory distress was observed in progenies borne from semen source B. Semen with 87.5% and 100% blood showed higher respiratory distress (66.66%) in progenies than semen with 75% and 93.75% blood (33.34%). The reason for higher respiratory distress in progenies from source B semen may be low quality semen, unhygienic calving pen, environmental risk factors, herd size or data recording system. Maltecca et al. (2006) found that predicted probability of respiratory disease for sires varied from 0.44 to 1.15%; that is, the lowest-ranking sire had a predicted probability of respiratory disease that was more than twice as high as that for the highest-ranking sire. Significant differences were not found between calves from crossbred sires and Holstein sires for respiratory disease, nor any differences found between Holstein sired calves from primiparous dams and multiparous dams in the study of Maltecca et al. (2006). Furthermore, he found liability to respiratory disease was slightly greater for heifer calves than for bull calves, and calves born with difficulties had a greater risk than other calves. Different microorganisms, several predisposing causes and environmental risk factors have been associated with respiratory problems found in the study of Snowder et al. (2006).

Hereditary (Bailgy and Mears, 1990), breed (Rathi and balaine, 1986), sex of calf (Avila et al., 1990), weight of dam (Bergh and Gerhard, 2010), nutrition, temperature, season (Musa, 2001) may influence the birth weight of calves. Current study showed that semen source has no effect on calf birth weight. This finding is in agreement with the study of Ibrahim et al. (2015) who reported that breed of sire had no significant influence ($P \geq 0.05$) on birth weight of calves. But different studies reported that sire has an effect on the birth weight of calves. Musa et al. (2001) reported that sire had significant effect on calf birth weight in Butana cattle. Abassa et al. (1986) reported that sire was a significant source of variation in birth weight in a herd of zebu cattle. Coleman et al. (2021) found in his study that birth weight of calves was affected by sire ($P \leq 0.001$). Effect of sire on birth weight include genotypic differences between breeds and differences between sires within breed (Bourdon and Brinks, 1982). The variation among sires for progeny birth weight indicated that choice of sire could change birth weight by as much as 8 kg in calving herds, even when selecting sires from within the same breed. European cross calves had heavier birth weights and zebu cross calves had low birth weights as a consequence of maternal influences studied by Notter et al. (1978). However, highest birth weight (62.86%) were recorded in calves produced from source A semen in this study. Maltecca et al. (2006) found that mean birth weight of calves from crossbred sires tended to be lower than that of Holstein sires, as indicated by a contrast of 1.9 kg. In addition, male calves were significantly ($P \leq 0.05$) heavier than females, and calves from primiparous dams were lighter than those from multiparous dams. Effect of semen source on sex of calves was also observed in this study. There was no variation in sex of progeny among different semen sources but source A semen comparatively produced highest percentage of female calves (53.33%). There was lack of published data related to effect of semen source on sex of progeny.

Effect of cow factors on progeny performance were also evaluated in this study. About 58.33% progenies showed congenital abnormalities who were born from more than 5 years old cows. Available information was not found regarding aging of dam and its relation to congenital abnormalities in progenies. Several reports showed that age of dam appears to affect the birth weight of either sex equally for cows ranging from 3 to 10 years of age (Koch and Clark, 1955). Reynolds et al. (1980) studied that age of dam had effect on calf survival rate ($p \leq 0.5$) and calf birth weight ($P \leq 0.1$).

In this study it was found that 55.56% progenies showed respiratory distress who were born from cows with BCS 3 or 4. Prolonged delivery time and its associated stress may be responsible for respiratory distress in calves. Over conditioned cows have increased incidence of peri and post-parturient problems found in the study of Lacetera et al. (2005) and Zula et al. (2002b). Available study was not found where BCS of dam and its effect on respiratory distress evaluated. Vargas et al. (1999) reported that BCS of dam tended ($P \leq 0.01$) to affect birth weight in first-parity dams. He reported that heifers with BCS 5, the lowest score within the parity group of his study, had calves with greater ($P \leq 0.05$) birth weight (33.1 ± 0.76 kg) than heifers with BCS 6 (30.5 ± 0.68 kg) or BCS 7 (31.9 ± 1.42 kg). BCS of cow did not affect birth weight of calves from second, third or greater parity dams. However, absolute values for mature cows showed a tendency for the birth weights of their calves to decrease with increased BCS.

Calf scour or neonatal calf diarrhoea (NCD) is one of the major health challenges in both beef and dairy cattle herds (USDA, 2010). This study showed that 62.50% progenies had calf scour who were born from non-vaccinated dams. This findings is similar to the study of Meganck et al. (2014) who has revealed that calves born from non-vaccinated dams are less likely to shed *Clostridium parvum* and suffer with calf scour (Trotz-Williams et al., 2007). Enterotoxic *Escherichia coli*, rotavirus, coronavirus, *C. parvum* and Giardia are the four most important enteropathogens causing NCD worldwide (Bartels et al., 2010). Prevalence of calf scour also appears to be management related especially when calves are housed in unhygienic conditions (Wudu et al. 2008). Helminthosis, and nutritional imbalances are also reported responsible for calf scour worldwide (Lema et al. 2001).

This study found that higher congenital abnormalities (75.00%) and high incidence of calf scour (68.75%) were found in progenies born from dewormed cows. There was lack of research conducted on the association of deworming in pregnant cows and its effect on newborn progenies. However, a clinical trial study was conducted in Uganda on pregnant women by Ndibazza et al. (2010) who revealed that anthelminthic treatment during pregnancy has no effect on congenital anomalies in babies. However, deworming is important to prevent the direct pathological effects of worms. Moreover, Elliott et al. (2007) hypothesized that helminth infection in dams may have long-term effects on the development of the fetal immune system.

The study found that 83.33% progenies showed congenital abnormalities obtained from semen source A. The study showed that 33.33% newborn calves suffered from respiratory distress born from 87.5% and 100% blood of semen source B. This study also revealed that aged cows showed higher congenital abnormalities (58.33%), over or poor conditioned cows showed higher respiratory distress (55.56%), and non-vaccinated cows showed highest calf scour (62.50%) in their newborn calves.

Chapter 6: Conclusions

The study found that higher percentage of congenital abnormalities in newborn calves were related to the semen source A and highest percentage of respiratory difficulties were associated with the semen source B. Effect of semen sources were not found on the sex and birth weight of progenies. This study also concluded that aged cows showed highest congenital abnormalities in their progenies and poor or over conditioned cows showed highest respiratory distress in newborns. Vaccinated dam reduced calf scour in their progeny.

Chapter 7: Limitations and Recommendations

Limitations

- The number of sample size were relatively low and result of this limited sample may repel its ability to generalize
- Short duration of the study period as well as sample collection
- Accidentally some inaccurate information may be incorporated
- Not all farmers have maintained the farm record books

Recommendations

- A larger sample size, wider geographic range and longer duration for the study targeted to identify at least one generation progeny performance might yield more precise conclusions about the best commercial semen
- Genomic study by expertise may needed to identify inbreeding or genes are causing congenital abnormalities
- Private companies should be evaluate their semen quality through progeny testing with veterinarian support

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Appendix-I: Questionnaire

Sl. No……..……………………………………

Date: …………………………..……………

Mob no. (Farmer/ owner) …………..…..………..

General information:

1. Name of the owner/farm: ……………………………………………………..
2. Address: ……………….……………………………………………….......
3. No. of cattle in farm: Local ……………………Cross ……………………...
   Bull : …………………………………… Cow: . ……………………………..
4. Source of semen: …………………………………………………………...
5. Breed of semen (HF/SL/RCC/other) ……………………………………….
6. Blood percentage of semen (50%/ 62.5%/ 75%/
   87.5%/93.75%/100%):……………………………………………………...

Cow's physiological and reproductive records:

1. Age: ………. ……………………………. …………………………………
2. Breed: ………………………………………. ……………………………...
3. Parity: ……………………………………………………………………….
4. BCS: ………………………………..………. ……………………………...
5. Vaccination: Yes/No……………………. ………………………………...
6. Deworming: Yes/ No ………………………. ……………………………...
7. Date of AI: ……………………………………………………………….
8. Estrous cycle (days): ……………………………………………………..
9. Calving interval: ……………………………. ……………………………..
10. Type of service: Natural/AI……………………………………. ……………..
11. Service per conception rate: ………………………..………………………
12. Expected date of delivery: …………………Actual delivery date: …………..
13. Delivery nature: Normal/assisted ……………..………………………........
14. Any abnormalities in or around delivery (RP/Abortion/still
    birth/metritis/pyometra/mummified fetus): …………………………………...

Progeny data:

1. Sex: ………. ………………………………………………………………..
2. Birth weight: …………………………………………………………………..
3. Congenital abnormalities: ………………………………………………………..
4. Respiratory dystress: ……………..…………………………..……………….
5. Navel infection: …………………………………………………………………..
6. Calf scour: ………………………………………………………………………..

Appendix-II

Interview with farm owners and employees

Brief Biography of the Student

The author, DR. Rahima Akther, passed the Secondary School Certificate Examination in 2010 followed by Higher Secondary Certificate Examination in 2012, from Karnaphully Paper Mill's High School and College, Rangamati. She obtained her Doctor of Veterinary Medicine (DVM) Degree in 2018 (held in 2019) from Chattogram Veterinary and Animal Sciences University (CVASU), Bangladesh. During her one year internship period of DVM, she received clinical training from University Putra Malaysia and also from Tamilnadu Veterinary and Animal Sciences University, India. Recently, she has completed Master of Science in Theriogenology under the Department of Medicine and Surgery, Faculty of Veterinary Medicine, CVASU. She is a carrier-oriented person and very passionate for her dream. She has immense interest to work in the field of reproductive biotechnology. In future, she wants to serve the country as a scientist.