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Evaluation of Fertility and Calving Ease of Small Holder Indigenous Cattle Herds in Semi-Arid Zone of Nigeria

Research Article

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ABSTRACT

This study had the objective of determining the fertility and calving ease of small holder indigenous cattle herds inseminated with imported semen from proven sires. Sixty one indigenous cows of different breed origin (Bunaji, Sokoto Gudali and Rahaji) were selected from different herds across Jigawa state-Nigeria, and were used for this study. The selected dams were inseminated with semen from proven bulls of three exotic breed origin (Holstein-Friesian, Brown Swiss and Gwuzera) using artificial insemination technique. Pregnancy diagnosis was conducted by rectal palpation 40 days after insemination to ascertain the pregnant ones; those that were not pregnant were re-synchronized and inseminated. The number of inseminations per cow per conception was recorded. Calving ease was evaluated and coded in two classes; 1 (unassisted calving) and 2 (assisted calving) while calf survival was 0 if the calf died within 24 hours from birth and 1 otherwise. The results showed that 54% of the cows had normal calving while 46% were assisted. Amongst the assisted calving, 89% of the calves survived while 11% died. The age, parity and dam body condition had significant effect (P<0.01) on calving ease of the dams. Calving ease increased with age, parity and body condition of the dam. The sire breed origin had no significant (P>0.05) effect on the number of insemination per conception but significantly influenced gestation length. Dam breed origin significantly (P<0.05) influenced number of insemination per conception and gestation length. The sire-dam breed combination showed that Holstein-Friesian-White x Fulani cross had the lowest percentage of calving difficulty (17%) with 0 mortality, indicating the high compatibility of these two breed origins. However, Sokoto Gudali was more compatible with all the 3 exotic sire breed origin Holstein friesian, Brown Swiss and Gwuzera studied with no mortality recorded. Therefore, results of this study on Bos taurus cattle and their crosses (*Bos taurus* x *Bos indicus*) suggests that the Sokoto Gudali dams are much more compatible with all the three exotic sire breeds, (Brown Swiss, Holstien-Friesian and Gwuzera) for crossbreeding purposes than White Fulani and Red Bororo dams.

KEY WORDS calving ease, fertility, smallholder cattle.

INTRODUCTION

Fertility is the ability of male and female animals to produce viable germ cells, mate, conceive and deliver normal living young. The lifetime productivity of a cow is influenced by age at puberty, age at first calving, calving interval and number of services per conception and calving to conception interval (Malau-Aduli *et al.* 1993; Mukasa-Mugerwa *et al.* 1992). Reproductive ability is the primary source of all benefits derived from livestock, but earlier selective breeding has focused on increased animal production traits (Oni *et al.* 1988; Shehu *et al.* 2005). The practice has resulted in substantial genetic progress. However, the above practice might lead to reduced fertility in the herds.

The reproductive performances of a herd have been shown to be one of the most important starting points in any animal improvement package (Mukasa-Mugerwa *et al.* 1992). This implies that, whatever the goal of the production system is, reproductive traits appear to be economically important in cattle improvement programmes.

Literally, dystocia is referred to as prolonged labor that exceeded the normal period of parturition 6-8 hours in cattle. Dystocia is also commonly known as calving difficulty. It is a major problem that most dairy and beef industries encounter. Dystocia is a leading cause of calf mortality at/or shortly after birth. It causes uterine infection, more retained placenta and long calving intervals (Cady, 2004). Calving difficulty has received much attention in recent years primarily because of mating larger European breeds bull with local breeds of cow (Cady, 2004).

The objective of this study therefore, was to determine the fertility and calving ease of small holder indigenous cattle herds inseminated with imported semen from 3 exotic proven sires.

MATERIALS AND METHODS

Location

The study was carried out in Jigawa state of Nigeria under the control of the Jigawa Research Institute (JRI) Kazaure Jigawa State, located between latitude 11.00^o and 13.00^o N and longitude 8.00^o and 10.15^o E and lies within the Sudan Savanna zone of Nigeria (JRI, 2003).

Experimental animals and management

Sixty one indigenous cows of different breed origin (Bunaji, Sokoto Gudali and Rahaji) were selected from different herds across Jigawa state and were used for this study. The selected dams were ear tagged, dewormed with Albendazol suspension and covered with antibiotics Oxytetracycline LA. The selected animals were grazed on natural pasture under the supervision of herdsmen for 7 to 9 hours daily, while sorghum stover supplemented with concentrate of wheat bran, were offered during the dry season. Salt lick and water were also offered *ad-libitum*. Only animals with body condition score of 3 and above were selected for the study. The selected dams were inseminated with semen from proven bulls of three exotic breed origin (Holstein-Friesian, Brown Swiss and Gwuzera) using artificial insemination technique. The dams were synchronized with PGF2α to induce the animals to come on heat at almost the same time. Once the animals are synchronized, they were isolated from the herd to avoid being mounted by breeding bulls. After which, they were inseminated. Pregnancy diagnosis was conducted by rectal palpation 40 days after insemination to ascertain the pregnant ones; those that were not pregnant were re-synchronized and inseminated. The number of inseminations per cow per conception was recorded.

Fertility rate

The fertility rate of the dam was measured as the number of conceptions per service or per insemination and recorded for each cow.

Calving traits

Calving traits were calving ease (CE) and calf survival (CS). Calving ease was coded in two classes; 1 (unassisted calving) and 2 (assisted calving). Calf survival was 0 if the calf died within 24 hrs from birth and 1 otherwise.

Body condition score (BCS)

The body condition score was determined on a scale of 1 to 5 based on the methods described by Allen (1990) and Webster (1993).

Fixed factors

The fixed factors that were considered were: age of dam, dam body condition, parity, sex of calf, season of calving, year of calving, sire breed and dam breed origin.

The seasons were grouped into four according to the weather pattern as follows:

Season 1: Early dry (October-December); Season 2: Late dry (January-March); Season 3: Early wet (April-June); Season 4: Late wet (July-September).

Data analysis

Chi square (χ^2) was used to analyze the distribution of calving ease according to age, breed, parity, and sex of calf, season of calving and year of calving. While, least square techniques of the general linear model (GLM) procedure of SAS (1998) was used to determine the effect of sire and dam breed origin on number of insemination and gestation length of the cows. The model used is as follows.

$$Y_{ijk} = \mu + \beta_i + \alpha_j + e_{ijk}$$

Where μ= Overall mean

β_i= Effect of ith dam-breed

α_j= Effect of jth sire-breed

e_{ijk}= Random error

RESULTS AND DISCUSSION

The characteristics of the breeding dams are shown in Table 1. Fifty four percent of the cows had normal calving while 46% were assisted. Amongst the assisted calving, 89% of the calves survived while 11% died. The mean birth weight of calves (29.5±0.42kg) observed in this study was higher than that reported by Adulli (1992), and Akpa *et al.* (2007) in Friesian-Bunaji and Friesian-Mpwapwa crossbred cows, but lower than 39.2±0.20kg reported by Gwaza *et al.* (2007) in Holstein Friesian cows. The higher birth weight observed here might be related to the influence of the genotype on birth weight which is consistent even under poor management.

The mean gestation length of 286.1±0.94 days in this study was higher than the 270 and 278 days as reported by Osei *et al.* (2004) and Gwaza *et al.* (2007), respectively. Also, the mean number of insemination per conception of cows in this study was close to the range of 1.3 to 1.5 reported by Radostits (2001), but lower than 1.98 and 2.15 reported by Stetshwaelo and Adebambo (1992), and Yohannes *et al.* (2001), respectively. The variations in the number of inseminations per conception is probably due to the quality of the semen and skill of the inseminators (Buckley *et al.* 2003).

Table 1 Characteristics of breeding dams in Kazaure and Environs

Characteristics	N	Mean (±SE)	CV (%)	Range
Age (years)	61	6.2±0.25	32	5 (4-9)
Parity	61	2.3±0.14	47	3 (1-4)
Body condition score	61	3.8±0.08	17	2 (3-5)
No of inseminations per conception	61	1.3±0.06	36	1(1-2)
Gestation length (days) 61	61	286.1±0.94	3	30 (271-301)
Birth weight ofcalves (kg)	61	29.5±0.42	11	12 (23.5-35.5)
Calving status: Normal calving	33	54		
Assisted calving	28	46		
Assisted and survived	(25)	89		
Assisted and died	(3)	11		

Numbers in parenthesis are ranges; SE: standard error; CV: coefficient of variation.

The variations in the number of inseminations per conception related to differences in dam breed origin indicated that apart from the viability of the semen and skill of the inseminator (Roche *et al.* 2000), the breed origin of the dam had a major role to play in the success of the insemination process in the indigenous cows of Nigeria. Although, there was no reported case of reproductive disorder in the cows assessed, Shiferaw *et al.* (2005) had observed that cows with reproductive disorders required more services per conception and that they had longer intervals from calving to first service and to conception. However, proper and accurate heat detection is a key to efficient reproduction. Also, this study showed that a good proportion of conception cases (31.15%) demanded more than one service per conception. This could suggest the presence of repeated breeders in the herd, erratic heat detection skills and inefficiency of artificial insemination (AI).

The distribution of the calving ease according to sire and dam breed origin and their combination (Table 2) revealed a variation in the calving ease of the dam. Although, the variation in the calving ease due to the effect of sire and dam breed origin suggests some level of genetic influence on dystocia, however, Cady (2004) reported that the heritability of calving ease is at low range from 5 to 15%, this means that, at most, about 85% of the variation in dystocia can be attributed to environmental or management factors. Consequently, the best method of reducing dystocia is through good management practices.

Table 2 The distribution of calving ease according to sire and dam breed origin and their combinations

Factor		Calving situation (%)		Assisted calving (%)	
	N	Normal	Assisted	Survived	Died
Sire breed	61				
Brown Swiss(BS)	27	52	48	92	8
Holstein Friesian (HF)	19	58	42	88	12
Guzera (GZ)	15	53	47	86	14
Dam breed					
White Fulani (WF)	18	56	44	75	25
Red Bororo (RB)	20	35	65	92	8
Sokoto Gudali (SG)	23	70	30	100	0
Sire-dam breed combination					
BSWF	7	43	57	75	25
BSRB	10	40	60	100	0
BSSG	10	70	30	100	0
HFWF	6	83	17	100	0
HFRB	7	17	83	80	20
HFSG	7	71	29	100	0
GZWF	5	40	60	67	33
GZRB	4	50	50	100	0
GZSG	6	57	33	100	0

BSWF= Brown Swiss x White Fulani; BSRB= Brown Swiss x Red Bororo; BSSG= Brown Swiss x Sokoto Gudali; HF x WF= Holstein Friesian x White Fulani; HFRB= Holstein Freisian x Red Bororo; HFSG= Holstein Friesian x Sokoto Gulai; GZWF= Guzera x White Fulani; GZRB= Guzera Red Bororo; GZSG= Guzera x Sokoto Gudali.

Therefore, proper management and breeding before, during and after calving is the key to preventing the problem.

In this study, both the sire breed origin and dam breed origin exhibited high percentage of difficult calving, ranging from 42-48% and 30-65%, respectively. This is higher than the 18.7% and 7.8% reported by Barbara *et al.* (2009) in Charolais and Limousine cows, respectively. This is probably due to one or combination of the following factors; age of dam, calf birth weight, pelvic area, cow size, breed of sire and dam, and hormonal control (Ritchie and Andreson, 1992).

The percentages of calving difficulty in the dams vary from 17% to as high as 83% depending on the sire and dam breed combination. Anderson (1992) presented results of calving difficulty on crossbred cows, in which all cows were crossbred with Hereford or Angus and the percentage of calving difficulty varied from 4 to 14%. The differences among breed of dam are most likely due to differences in relative pelvic area, muscling or fatness. The Holstein-Friesian x Red Bororo crossbred had the highest percentage frequency (83%) of calving difficulty. This is probably due to incompatibility between the two breeds as well as the size of pelvic canal of the dam. The pelvic opening determines the maximum birth weight that can be accommodated by individual cows before calving difficulty is experienced. Likewise, Cady (2004) attributed the prevalence of calving difficulty to the mating of larger European breed bull with local breeds of cows. Calving difficulty increased mortality to as high as 33% in Guzera-White Fulani crosses, 25% in Brown Swiss x White Fulani and 20% in Holstein-Friesian x Red Bororo. This is comparable to the 20% of calving difficulty reported by Radostis *et al.* (1994).

Research has demonstrated that significant differences exist between breed of sire and breed of dam in calving difficulty (Ritchie and Andreson, 1990). This confirms the variation in calving ease observed in the present study with regard to sire and dam breed origin differences. Breed difference in respect of calving ease is an important factor for genetic improvement of the efficiency of beef and dairy production. In this study, Holstein-Friesian x White Fulani cross (HFxWF) had the lowest percentage of calving difficulty (17%) with zero mortality, indicating the high compatibility of these two breed origins. However, Sokoto Gudali was more compatible with all the 3 exotic sire breed origins (HF, BS and GZ) studied. This is additionally evidenced considering the fact that the Sokoto Gudali (SG) cross-combinations (BSxSG, HFxSG and GZxSG) presented a high percentage of normal calving (67-71%) with no mortality recorded. This suggests that the SG dams are much more compatible with the entire three exotic sire breeds (BS, HF and GZ) for crossbreeding purposes than White Fulani and Red Bororo dams.

The distribution of calving ease according to age, parity and body condition of dam is shown in Table 3. The variation of calving ease due to the effect of age, parity and body condition of the dam observed in this study is in line with the reports of Ritchie and Anderson (1990), Akpa *et al.* (2002). Calving ease increased with age, with the 9 year old dams having the highest (80%) normal calvings. All calves from the assisted calving of dams that were more than 4 years of age survived, while those of 4 years had 20% mortality. Equally, calving ease increased with parity and body condition of dam with highest parity and body condition producing the best calving ease of 89 and 67%, respectively. This is in line with report of Akpa *et al.* (2002) that age and size of dam caused dystocia, especially among dams of first parity that were young.

Table 3 Distribution of calving ease according to age, parity and body condition of dam

Factor		Nature of calving (%)		Assisted calving (%)	
	N	Normal	Assisted	Survived	Died
Dam age (years)	61	df: 8, x^2= 11.232; P<0.01			
4	25	38	62	80	20
6	9	67	33	100	0
7	6	67	33	100	0
8	11	45	55	100	0
9	10	80	20	100	0
Parity of dam	61	df: 6, x^2= 20.246; P<0.01			
Parity 1	19	21	79	80	20
Parity 2	15	73	27	100	0
Parity 3	18	56	44	100	0
Parity 4	9	89	11	100	0
Dam BCS	61	df: 4, x^2= 2.013; P<0.01			
BCS 3	21	22	48	80	20
BCS 4	34	53	47	94	6
BCS 5	06	67	33	100	0

χ^2: chi square; df: degree of freedom; P<0.01= 1% level of significance.

Dam BCS: Dam body condition score.

Also, Cady (2004) reported that first calving heifers experience problems twice as often as older cows since they are usually not full grown. Dams of first parity had the highest percentage (79%) of assisted calving with 20% mortality, beyond the first parity all the calves of assisted calving survived. Also, dams with BCS of 3 had the highest percentage (48%) of assisted calving with 20% mortality, while dams with BCS of 5 had 33% assisted calving with zero mortality. However, multiparious aged dams are sometimes affected, probably due to decreasing ability of the older dams to cope with pregnancy and the associated stress. The decrease in calving difficulty with increase in body condition of the dam from 3 to 5 (on a scale 1 to 5) is probably due to the earlier observation of Vargas *et al.* (1999) that absolute values for mature cows shows tendency for the birth weight of their calves to decrease with increased in body condition score of the dam. The variation of calving ease with sex of calf, season and year of calving is shown in Table 4.

Table 4 Distribution of calving ease according to sex of calf, season and year of calving

Factor		Nature of calving (%)		Assisted calving (%)	
	N	Normal	Assisted	Survived	Died
Sex	61	df: 2, x^2= 11.426; P<0.01			
Male	35	37	63	54	46
Female	26	77	23	100	0
Season of calving	61	df: 3, x^2= 9.595; P<0.01			
Early dry	13	23	77	80	20
Late dry	27	63	37	90	10
Early wet	14	57	43	100	0
Late wet	7	72	28	100	0
Year of calving	61	df: 6, x^2= 4.277; P<0.01			
2004	15	36	64	78	22
2005	31	58	42	92	8
2006	9	56	44	100	0
2007	6	67	33	100	0

χ^2: chi square; df: degree of freedom; P<0.01= 1% level of significance.

The female bearing calves had lower calving difficulty (23%) than the male bearing calves (63%), and with no mortality recorded. This is probably due to the fact that male fetuses grow faster during gestation and will have heavier weight at birth than females' calves (Gwaza *et al.* 2007; FAO, 2008). In the same vein Ritchie and Anderson (1990) reported that much of the influence of sex of calf on calving difficulty is believed to be indirect through its effect on calf size. Also, Akpa *et al.* (2002) reported that the effect of sex of calf is associated with the size of the fetus at birth and that it was more prominent for dams with male offsprings which were heavier than those of their female counterparts.

Calving ease was highest during the late wet (72%) followed by the late dry (62%) and early wet (57%). Early dry season has the highest assisted calving (77%) and mortality of calves (20%).

The effect of season of calving on the calving ease of the dam is related to the stage in the wet and dry season cycle at which the dam became pregnant. Most farmers associated poor feeding with calving difficulty as feeding of animals become more difficult during the dry season and can affect the animals especially if it corresponds with the period of pregnancy (Akpa *et al.* 2002). Other authors have reported significant effect of year and season of calving on birth weight of the calves (Ehoche *et al.* 1992; Tawah *et al.* 1999; Ebangi *et al.* 2002; Akpa *et al.* 2007) and research has shown that birth weight is a major factor that can influence calving ease (Ritchie and Anderson, 1990). However, the variation of calving difficulty with year and season of calving is an indication of the effect of management practices, housing, disease prevention, feeding and nutrient content of feed offered to the animal, during gestation (Gwaza *et al.* 2007).

The effect of sire and dam breed origin on number of inseminations per conception and gestation length is shown in Table 5.

Table 5 Effects of sire and dam breed origin on number of inseminations per conception and gestation length

Factors	N	No of inseminations	Gestation length
Sire breed	61	ns	*
Brown swiss	27	1.4	284.67^c
Holstein friesian	19	1.3	288.05^a
Guzera	15	1.3	286.27^b
Mean		1.3	286.33
SEM		0.06	0.98
Dam breed	61	*	*
White Fulani	20	1.3^b	283.69^b
Red Bororo	18	1.6^a	282.30^b
Sokoto Gudali	23	1.1^c	288.50^a
Mean		1.3	284.83
SEM		0.06	1.87

a, b, c: means with different superscripts along a column differ significantly (P<0.05); ns: non significant; SEM: standard error of means.

The sire breed origin had no significant (P>0.05) effect on the number of inseminations per conception but significantly (P<0.05) influenced gestation length. Gestation length was longest for dams sired by Holstein-Friesian (288.05 days) and least for those sired by Brown Swiss (284.67 days). The mean gestation length of the dams in relation to both the sire breed origin (286.33 days) and dam breed origin (284.83 days) observed in this study was higher than the 270 days reported by Gwaza *et al.* (2007) and Osei *et al.* (2004) in Holstein-Friesian cows.

The significant effect of sire breed origin on the gestation length in this study is in agreement with the reports of Gwaza *et al.* (2007); but contrary to the results of this study, Gwaza *et al.* (2007) reported no significant effect of dam breed origin on gestation length.

The variations in gestation length with breed origin observed in this study had also been reported by Goyache *et al.* (2002). The effect of sire breed on the number of inseminations was not significant (P>0.05), however, dam breed origin significantly (P<0.05) influenced number of inseminations and gestation length. The lowest number of inseminations per conception was observed in Sokoto Gudali's dams (1.1) and the highest (1.6) for Red Bororo dams.

CONCLUSION

Holstein Friesian-White Fulani (HFWF) cross-combination were the most compatible dam and sire breed combination with the highest percentage of normal calving (83%) and without a single mortality recorded. However, Sokoto Gudali was more compatible with the entire 3 exotic sire breeds (HF, BS, GZ) studied.

This is additionally evidenced considering the fact that the Sokoto Gudali (SG) cross-combinations (BSSG, HFSG and GZSG) presented a high percentage of normal calving (67-71%) with no mortality recorded. This suggests that the SG dams are much more compatible with all the three exotic sire breeds (Brown Swiss, Holstien-Friesian, Gwuzera) for crossbreeding purposes than White Fulani and Red Bororo dams. Also, sire breed origin does not constitute sources of variation in number of inseminations per conception while dam breed origin did. Therefore, the breed origin of the dam has a major role to play in the success of the insemination process in the indigenous cows of Nigeria.

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