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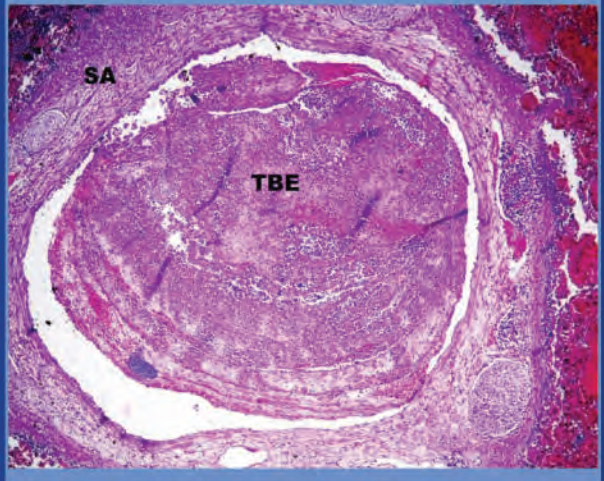

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Full length articles

Short Communication

Full Length Articles

Type of whelping and its infleunce on Apgar score

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ABSTRACT

The modified Apgar score for puppies was evolved based on the reference range of heart rate, respiration, irritability reflex, motility and membrane mucous colour according to the physiology of canine neonate. A total of 100 puppies born to the bitches that underwent Spontaneous Whelping (SW), Assisted Whelping (AW) and Caesarean section (CS) were selected and were divided into III groups viz. SW (n=30), AW (n=35) and CS (n=35).A modified Apgar score model was used to assess neonatal viability of the puppies. Among the total 100 pups evaluated 36, 13 and 51 pups were having Apgar scores of 0 to 4, 5 to 9 and 10 to 14, respectively. Out of 36 pups having Apgar scores of 0 to 4 at birth, 5.56, 19.44 and 75.00 per cent of pups were born through SW, AW and CS, respectively. Among 13 pups born with Apgar scores of 5 to 9 at birth, 0, 38.46 and 61.54 per cent of pups were born through SW, AW and CS, respectively. Out of 51 pups with Apgar scores of 10 to 14 at birth, 54.90, 45.10 and 0 per cent of pups were born through SW, AW and CS, respectively.Among the viable pups at birth, the pups born through CS were having low and medium Apgar scores of 0 to 4 and 5 to 9, respectively. All the pups delivered through SW had highest Apgar scores at birth while the pups delivered through AW had shown Apgar scores between 5 to 9 and 10 to 14.

Keywords: Apgarscoringsystem, Canine, Dystocia, Puppies, Mortality

INTRODUCTION

The incidence of neonatal mortality following normal delivery is reported to be as high at 9 to 26 per cent (Davidson, 2014) and 30 to 40 % (Mosier, 1986) following complicated whelping in dogs. Till date, there are very few reports on the use of Apgar scoring system to evaluate newborn puppies, mainly due to the polytocous condition of the dog. The modified Apgar score for puppies was

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evolved based on the reference range of heart rate, respiration, irritability reflex, motility ad membrane mucous colour according to the physiology of the canine neonate (Veronesiet al., 2009).

MATERIALS AND METHODS

The present study was conducted in the puppies born to bitches of different breeds brought to the Small Animal Gynaecology and Obstetrics outpatient ward (SAP-OP-OG) of Madras Veterinary College Teaching Hospital with the history of progressive whelping and / or dystocia.A total of 100 puppies born to the bitches that underwent Spontaneous Whelping (SW), Assisted Whelping (AW) and Caesarean section (CS) were selected and were divided into III groups as follows.

Group I (n=30) comprises of Spontaneous Whelping in which puppies which were born to five bitches through spontaneous whelping without any assistance. No medical/manual or surgical assistance were given to the bitches for delivering the puppies. Group II (n=35) comprises of assisted whelpingin which puppieswere born to 10 bitches that delivered through either manual or medical assistance. Manual assistance was attempted to the puppies which were partly expelled from the vagina and/or the puppies whose parts were within reach on vaginal examination but not progressed further. Medical assistance was supported with induction protocol with slow intravenous injection of oxytocin @ 1.1 to 2.2 IU/kg IM or SC with a dose range between 5 and 20 IU every 30 min and concurrent administration of 10% calcium gluconate @ 0.5 to 1.5 ml/kg to augment oxytocin's effect on myometrial contraction and intravenous fluids to correct hydration, electrolyte, and blood glucose abnormalities.Puppies born to 9 bitches that underwent caesarean section were included in group III. Under general anaesthesia using propofol @ 3 mg/kg and diazepam @ 0.5mg/kg for induction and 2 per cent isoflurane for maintenance, caesarean section was performed through mid-ventral approach by adopting standard surgical procedures The Apgar scores were evaluated at birth, 30 min, 2 and 24h after birth.

A modified Apgar score model developed by Groppetti et al. (2010) (Table 1) was used to objectively assess neonatal viability of the puppies. The following parameters were evaluated: mucous membrane colour, heart and respiratory rate, reflex irritability, mobility, suckling, and vocalization, as described in Table 1. Each parameter was assigned a value 0, 1, or 2. Apgar score for each pup is the summation of the value of each parameter.

The number of animals in each category is expressed as percentage of total number of animals in that category.

RESULTS AND DISCUSSION

Percentage of pups with different Apgar scores at birth in relation to type of delivery is presented in Table 2. Among the total 100 pups evaluated, 36, 13 and 51 pups were having Apgar scores of 0 to 4, 5 to 9 and 10 to 14, respectively. Out of 36 pups having Apgar scores of 0 to 4 at birth, 5.56 (2/36), 19.44 (7/36) and 75.00 (27/36) per cent of pups were born through SW, AW and CS, respectively. Among 13 pups born with Apgar scores of 5 to 9 at birth, 0, 38.46 (5/13) and 61.54 (8/13) per cent of pups were born through SW, AW and CS, respectively. Out of 51 pups with Apgar scores of 10 to 14 at birth, 54.90 (28/51), 45.10 (23/51) and 0 per cent of pups were born through SW, AW and CS, respectively.

The survival rate of the puppies at birth, 30 min, 2 h and 24 h in relation to type of delivery and Apgar scores is presented in Table 3. Out of 75 viable pups at birth, 14.67 (11/75), 17.33 (13/75) and 68.00 (51/75) per cent pups were showing an Apgar scores of 0 to 4, 5 to 9 and 10 to 14, respectively.

Among 67 viable pups at 30 min, 5.97 (4/67), 11.94 (8/67) and 82.09 (55/67) per cent pups were showing Apgar scores of 0 to 4, 5 to 9 and 10 to 14, respectively. Out of 11 pups born through CS that had low Apgar scores of 0 to 4 at birth, 6 pups died within 30 min. Of the remaining 5 pups, one pup had an improved Apgar scores of 5 to 9 at 30 min while the remaining 4 pups continued to show low Apgar scores. Out of 13 live pups that had Apgar scores of 5 to 9 at birth, 2 died within 30 min and 4 had improved Apgar score of 10-14. The remaining 7 pups continued to show low Apgar scores of 5 to 9 at 30 min. (Totally, 8 pups showing 5 to 9 Apgar score at 30 minutes is because one pup had improved Apgar score from 0-4 at birth to 5-9 at 30 min)

Out of 61 viable pups at 2 h, 1.64 (1/61), 4.92 (3/61) and 93.44 (57/61) per cent of pups were having Apgar scores of 0 to 4, 5 to 9 and 10 to 14, respectively. In CS group, out of 4 pups which had low Apgar scores of 0 to 4 at 30 min, 3 pups died and one pup remained in the same group at the end of 2 h and subsequently died at 24 h. Out of 8 pups which had Apgar scores of 5 to 9 at 30 min, 3 died and 2 had improved Apgar scores of 10 to 14 at the end of 2 h. The remaining 3 pups failed to survive through 24 h.

All the 57 live pups at the end of 24 h showed Apgar scores of 10 to 14. Out of 28 pups live at birth born through spontaneous whelping all had good Apgar scores of 10 – 14 and all survived after 24 h. In the AW group, of the 13 pups, 5 had scores of 5-9 at birth, of which 2 died and the remaining 3 showed improved Apgar scores at 2 h and further survived after 24 h. All the remaining 23 pups of this group with Apgar scores of 10 – 14 survived after 24 h.

Among the viable pups at birth, those with low and medium Apgar scores of 0 to 4 and 5 to 9, respectively, were more in the CS group. All the pups delivered through SW had highest Apgar scores at birth while the pups delivered through AW had shown Apgar scores between 5 to 9 and 10 to 14. This is in accordance with the results of Groppettiet al. (2010) who have reported 92 per cent pups delivered through CS, had shown poor Apgar. This reduction in the Apgar scores in CS group might be due to the effect of anaesthesia used in the CS. Propofol is a short acting hypnotic agent and provides rapid induction of recovery from anaesthesia and it crosses placental barrier. Propofol is also reported to cause more cardio respiratory depression and increased PCO2 which might be the reason for reduced Apgar scores in the pups delivered through the CS.

Similar results of the pups delivered through CS having lowest Apgar scores and that of SW with highest Apgar scores and those delivered through AW with intermediate and high Apgar scores were found at 30 min, 2 and 24 h. These results were in accordance with that of Veronesi et al. (2009), Groppettiet al. (2010) and Jayakumar et al. (2015). Bharathidasan et al. (2016), who reported that low Apgar scores in the pups delivered through CS beyond 4 and a half hour after the onset of labour and have added that the duration of delivery had an indirect relationship with the Apgar scores. They have also added that CS should be performed within 4.5 h after the onset of second stage of labour and the number of inductions should be limited to one.

All the 28 live pups born through the SW at birth were having Apgar scores of 10 to 14 and all of them survived beyond 24 h. This result is similar to that of Jayakumaret al. (2015) whoreported that all the live pups born through SW have survived beyond 60 min, the numbers of which are slightly higher than Veronesi et al. (2009) who have reported that 92.6 per cent pups born through SW survived beyond 24 h.

Among the 28 live pups born through AW at birth, 23 were having Apgar scores of 10

to 14 and all survived beyond 24 h. Of the 5 pups having moderate Apgar scores of 5 to 9 at birth, 2 died and 3 pups had improved Apgar scores of 10 to 14 at the end of 24 h. Significant improvement in survival rates were observed when Apgar scores improved from medium to high grade at 2 h of evaluation after resuscitation,. The beneficial effects of resuscitation procedures were more apparent in improving the Apgar scores of puppies born with medium Apgar scores. Though dystocia promoted a long lasting bradycardia and slowed down Apgar scores progression in pups (Lucio et al., 2009), resuscitation measures helped to attain satisfactory improvement.

Among 19 live pups born through CS, 11 were having low Apgar scores of 0 to 4 and died at 30 min. 8 were having moderate Apgar scores of 5 to 9, among which 3 had improved to high Apgar scores of 10 to 14 at 2 h and remaining 5 pups died even after adopting resuscitation procedure. Systemic evaluation of puppies in this study allowed the timely detection of puppies with poor Apgar scores that might otherwise have been overlooked at birth. Three out of 8 pups with Apgar scores of 5 to 9 recovered completely which proved that prompt detection of less viable newborns, followed by attempts to resuscitate, could improve neonatal survival.

To conclude, the type of delivery had a significant impact on Apgar scores with survival rate being lowest for pups born of CS and adequate prompt adoption of resuscitation measures would help in reducing the neonatal mortality in pups.

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Table 1.
Apgar score model used in this study

Parameters	Score 0	Score 1	Score 2
Mucous colour (Appearance)	Cyanotic, pale	Pink	Reddish
Heart rate (BPM)	<120	120-180	>180
Respiratory rate (bpm)	<15	15-30	>30
Reflex irritability	None	Feeble reaction	Active reaction
Mobility	None	Hypo-mobility	Active mobility
Suckling	None	Weak	Energetic
Vocalization	None	Mild	Vigorous

BPM: beats/min; bpm: breaths/min

Table 2.
Percentage of pups with different Apgar scores at birth in relation to the type of delivery

Type of delivery	Total no. of pups (n)	% of pups with different Apgar scores at birth		
		0 to 4	5 to 9	10 to 14
Spontaneous whelping	30	5.56 (2)	0.00	54.90 (28)
Assisted whelping	35	19.44 (7)	38.46 (5)	45.10 (23)
Caesarean section	35	75.00 (27)	61.54 (8)	0.00
Total	100	36	13	51

Values within parenthesis indicate numbers.

Table 3.
Survival rate of the puppies at birth, 30 min, 2 h and 24 h in relation to type of delivery and Apgar scores

Type of Whelping	Percentage of viable pups with different scores											
	At birth			At 30 min			At 2 hrs			At 24 hrs		
	0 to 4	5 to 9	10 to 14	0 to 4	5 to 9	10 to 14	0 to 4	5 to 9	10 to 14	0 to 4	5 to 9	10 to 14
Spontaneous whelping	0	0	54.90 (28)	0	0	50.91 (28)	0	0	49.12 (28)	0	0	49.12 (28)
Assisted whelping	0	38.46 (5)	45.10 (23)	0	37.50 (3)	41.82 (23)	0	0	45.62 (26)	0	0	45.62 (26)
Caesarean section	100.00 (11)	61.54 (8)	0	100.00 (4)	62.50 (5)	7.27 (4)	100.00 (1)	100.00 (3)	5026 (3)	0	0	5.26 (3)
Total	**14.67 (11)**	**17.33 (13)**	**68.00 (51)**	**5.97 (4)**	**11.94 (8)**	**82.09 (55)**	**1.64 (1)**	**4.92 (3)**	**93.44 (57)**	**0**	**0**	**100.00 (57)**

Values within parenthesis indicate numbers.

Lifetime semen production performance of cattle and buffalo bulls

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ABSTRACT

Semen production performance data of 88 buffalo and 179 cattle bulls of different breeds from 1975 to 2018, were collected from two frozen semen stations of BAIF Research Development Foundation. The objective of the present study was to document the lifetime semen producing performanceof cattle and buffalo bulls. Traits studied were lifetime frozen semen production doses (LFSP),lifetime production period (LPP),age at first semen production (AFSP) and age at last semen production (ALSP). The factors tested for influence on these traits were breed, period and season of birth.Overall means of AFSP, ALSP, LPP and LFSP were 1859.6, 4257.2, 2581.7 days and 183631.9 semen doses in buffalo bulls, while 1386.7, 4029.4, 2076.16 days and 264566.3 semen doses in cattle bulls.Production performance for results obtained for various breeds could be useful in devising important culling and disposal policies for AI centres in the country.

Key words: Semen Production, Lifetime Production, Breed

INTRODUCTION

Artificial insemination (AI), one of the widely used biotechnological tools is used to coverthe large population of cattle and buffalo in India. AI is not only used for the genetic improvement of livestock but also for the conservation purpose.With the consistent growing population of cattle and buffalo (PKR, 2019), mostly consisting of non-descript population, the demand for good quality semen is on rise to upgrade the non-descript population.

The information on semen production capacity of bulls of different breeds would prove useful inplanning to covermaximum breedable population. The requirement of semen doses of a

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particular breed over a period of time would help decide a minimumproduction target.A knowledge of the average first and last collection of freezable semen would help serve in the selection, culling and replacement decisions as the AI centersneed adult bulls and testing bulls to replace the adult stock. With this objective, the present study was designed to document the lifetime semen producing performance of cattle and buffalo bull breeds reared in the AI Stud Farm.

MATERIALS AND METHODS

Semen production performance data of 88 buffalo and 179 cattle bulls of different breeds were collected from two frozen semen stations of BAIF Research Development Foundation, viz. Uruli Kanchan, Pune, Maharashtra for the years between 1975-2018,and at Dharouli, Jind, Haryanafor the years between 2011-2018.The buffalo breeds included in the study were Banni (2), Bhadawari (4), Murrah (66), Jaffarabadi (5), and Surti(11) while the cattle breeds included in the study were Gir (16), Hallikar (4), Holstein Friesian (HF)100% (30), HF50% (31), HF62.5% (4), HF75% (27), Jersey 100% (25), Jersey 50% (12), Jersey 62.5% (7), Jersey 75% (9), Khillar, (2) and Sahiwal (12). The date of birth, first and last collection records and frozen semen doses produced per ejaculate were utilized for the analysis. The traits considered for the analysis were lifetime frozen semen production doses(LFSP),lifetime production period (LPP),age at first semen production (AFSP) and age at last semen production (ALSP). The period of birth was divided into five groups viz. <1980, 1981-1990, 1991-2000, 2001-2010 and 2011-2018. Season of birth were divided into three categories viz. summer (March to May), monsoon (June to October) and winter (November to February). Until 2004, the sperm concentration per frozen semen dose was 30 million. From 2005 onwards, the sperm concentration per semen dose was revised from 30 million to 20 million per dose. Considering this fact, the LFSP was studied only for the period after 2005. The records were subjected to statistical analysis using least square analysis using "*lm*" function in R statistical software (RCT, 2019 version 4.0.1.). Along with "*lm*" function, "*car*" and "*agricolae*" packages were used for computing ANOVA (Type III sum of square) and Duncan's multiple range test. The model for the analysis is given below:

$$Y_{ijkl} = \mu + B_i + S_j + A_k + e_{ijkl}$$

Where,

Y_{ijkl} = Lifetime semen production performance trait

μ = Overall mean

B_i = Effect of m^{th} breed (m = 1 to 5 or 12)

S_j = Effect of n^{th} season of birth (n = 1 to 3)

A_k = Effect of k^{th} period of birth (k = 1 to 5)

e_{ijkl} = Random error associated with Y^{ijkl} which is assumed to be normally and independently distributed with mean zero and constant variance

RESULTS AND DISCUSSION

Lifetime semen production performances of Buffalo and Cattle bulls

The least square means of lifetime frozen semen production traits like age at firstsemen production (AFSP) and last semen production (ALSP), lifetime frozen semen production doses (LFSP) and lifetime semen production period (LPP) of buffalo and cattle bulls are presented in Tables 1 and 2, respectively.

Breed had significant effect on AFSP. Banni and Bhadawari breeds had a higher AFSP in comparison with the other breeds while Murrah had the lowest AFSP. LFSP was highest in Murrah and lowest in Bhadawari buffalo breed. Banni and Jaffarabadi bulls did notdifferfrom each other in

these traits. Breed showed no significance for the ALSP, LFSP, and LPP traits.

The breed differences in the age at first collection of buffalo bull semen were due to difference in the age of the bulls purchased. Murrah bulls were purchased at a very young age of 18 to 24 months, while Banni and Bhadawari bulls were purchased at a comparatively older age of 3 years, subsequently thus delaying the collection of their first ejaculate. Mukhopadhyay *et al*. (2010), Khatun *et al*. (2013) and Ramajayan (2016) had reported a still lower age at first semen collection in Murrah buffaloes. Early sexual maturity leads to collection of semen at an early age resulting in an overall production of semen doses, reduction in generation intervaland subsequentlyresulting inincreased genetic gain.

Breed effect on lifetime production of semen doses was particularly due to preferential treatment at the semen station over the bulls. Murrah breeds are in huge demand in the field unlike the Banni and Bhadawari which have a very small breeding tract.They are also not been used for grading up purposes. Thus, the cattle breeds with less demand were subjected to fewer collections of semen and which resulted in the production of lesser number of doses.

From the averages presented for age at last semen collection and lifetime production period, it was also observed that on an average, the semen collection was carried out for approximately 8-9 years of productive life and which was found similar for all the breeds and may perhaps explain the reason for the non-significant effect due to breed.

All the lifetime production traits except LPP was found to be significantly affected by breed factor in cattle. AFSP was found to be the lowest in HF pure bulls. However, HF pure bulls did not differ significantly from other HF crossbreds and Jersey and their crossbred bulls except Jersey 62.5% bulls which had the highest AFSP. Indigenous bulls showed comparatively a higher AFSP and ALSP than the exotic and crossbred bulls. HF 100% bulls had the highest LFSP means in comparison to other breeds. Apart from Gir and Hallikar bulls, all the other breeds did not differ statistically from each other.

The different genotypic groups present, the number of bulls available in a particular genotype, the demand in field and the age of puberty was found to have a significant effect on all the lifetime semen production traits except lifetime production period in cattle.The exotic breeds HF and Jersey had a lower age of semen production and thus produced higher semen doses in comparison with the other breeds. This was followed by the crossbred bulls which had a lesser age at puberty in comparison with the indigenous breeds of cattleand which had a huge demand in the field for crossbreeding purposes.Thus the semen production from each pure and crossbred bull was observed to be higher than that produced by the indigenous bulls. The *Bos taurus* bulls attain sexual maturity at the age of 8 to 10 months of age while the *Bos indicus* bulls take a little longer to attain sexual maturity viz., 16-18 months (Wolf *et al.*, 1965; Almquist *et al.*, 1976; Lunstra *et al.*, 1978; Chenoweth *et al.*, 1996 and Vale Filho *et al.*, 1997). Brito *et al.* (2002) reported a slightly higher age at puberty in crossbred bulls (13.8 months; 421 days). Age at puberty depends on the early release of gonadotropin secretion and which usually increases between 2 to 5 months after birth. It had been observed that the pattern of secretion of gonadotropin differedbetween the early and late maturing bulls. A higher concentration of luteinizing hormone was found in early maturing bulls than in late maturing bulls(Evans *et al.*, 1995 and Aravindakshan *et al.*, 2000). Age at last semen production in cattle bulls showed little variation among the breeds (Table 2). It was also observed that the average lifetime production period among the cattle breedsin the present study was 6 to 7

years. This may perhaps explain the reason why there was no difference among the breeds for lifetime production period.

Age at first and last semen collection among the HF and Jersey crossbred and Sahiwal breed cited by different researchers (Rao, 1984; Suryaprakasam and Rao, 1993; Chauhan*et al.*, 2010; Mukhopadhyay *et al.*, 2010; Gopinathan, 2014; Khatun *et al.*, 2013 and Thippesamy *et al.*, 2014) reveal slightly lower means than the present study. Similarly, the lifetime production period and semen doses reported by Mukhopadhyay *et al.* (2010) and Gopinathan (2014) in Jersey and HF crossbred bulls were found to be lower than observed in the present study. The difference among the earlier reports and present study may perhaps be attributed to management measures practicedin the semen stations.

Period of birth had a significant effect on all the lifetime semen production traitsin cattle and buffalo bulls (except for lifetime frozen semen production in which the period of birth effect was not tested).The significant difference among the traits due to periodmay be due to the number of bulls studied and the increase in demand in the last two decades.Season of birth had no statistically significant effect on any lifetime production traits of both cattle and buffalo bulls.

SUMMARY

Production performance for results obtained for various breeds could prove useful in culling decisions and disposal policies for AI centres in the country.

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Table 1.

Least square mean of lifetime semen production traits in buffalo bulls

Levels	AFSP	ALSP	LFSP	LPP
Overall mean	1859.6±110.52	4257.2±229.8	183631.9±25077	2581.7±235.2
Breed	**	NS	NS	NS
Banni	2056±234.1[a]	5175±710	171812±65962	2765±736
Bhadawari	2270±188.4[a]	4548±524	100053±65300	1771±543
Jaffarabadi	1782±120.3[ab]	4538±480	209573±47807	2644±498
Murrah	1585±78.1[b]	4835±170	242330±21673	3166±176
Surti	1729±110.1[ab]	5039±301	-	2991±312
Period of birth	**	**	-	**
≤1980	1416±269[a]	6477±536[a]	-	2975±555[ab]
1981 to 1990	1315±137[c]	4916±291[b]	-	3441±301[a]
1991 to 2000	1712±129[b]	3850±320[c]	-	1725±332[b]
2001 to 2010	1288±109[c]	4065±208[c]	-	2528±216[b]
2011 to 2018	1567±226[bc]	-	-	-
Season of birth	NS	NS	NS	NS
Summer	1879±133	4781±296	175205±33227	2629±307
Monsoon	1849±117	5017±275	166817±44333	2816±286
Winter	1851±116	4684±284	200804±34978	2557±294

(**LFSP**: Lifetime frozen semen production doses; **LPP**: Lifetime production period; **AFSP**: Age at first semen production; **ALSP**: Age at last semen production)

Table 2.

Least square mean of lifetime semen production traits in cattle bulls

Levels	AFSP	ALSP	LFSP	LPP
Overall mean	1386.71±67.8	4029.4±109.08	264566.3±23939.1	2076.16±148.6
Breed	**	*	*	NS
Gir	1495±148.4[b]	4162±270[b]	151015±50337[b]	1844±291
Hallikar	1741±277.5[ab]	4263±504[b]	122239±87186 [b]	1502±543
HF100%	757±52.6[b]	3936±176[b]	391348±45254[a]	2295±189
HF50%	1259±99.5[b]	4247±197[ab]	298543±62184[ab]	2382±212
HF62.5%	1203±163.2[b]	5131±511[ab]	-	2293±551
HF75%	1135±74[b]	4395±209[ab]	347515±49024[ab]	2480±225
JR100%	941±59[b]	3910±178b [ab]	236561±53524[ab]	2176±192
JR50%	1211±134.3[b]	4731±297[ab]	354490±67826[ab]	2711±320
JR62.5%	2256±189.1[a]	5442±377[a]	-	1660±407
JR75%	1218±157.3[b]	4332±336[ab]	313282±107676 [ab]	2175±362
Khillar	1315±366[b]	3996±699[b]	187285±111309 [ab]	1742±754
Sahiwal	1663±150.8[ab]	4392±298[ab]	243387±89101 [ab]	1648±321
Period of birth	**	**	-	**
≤1980	1547±104.6[b]	5049±378[a]	-	1089±408[a]
1981 to 1990	1762±104.1[a]	4836±192[ab]	-	2154±207[b]
1991 to 2000	1290±86.2[b]	3952±147[b]	-	2530±159[b]
2001 to 2010	1193±69.9[b]	3809±133[b]	-	2530±143[b]
2011 to 2018	1268±93.6[b]	-	-	-
Season of birth	NS	NS	NS	NS
Summer	1463±82	4332±174	239561±41027	2047±187
Monsoon	1383±76.8	4536±184	241412±36884	2079±199
Winter	1390±77	4367±158	312726±36699	2100±170

(**LFSP**: Lifetime frozen semen production doses; **LPP**: Lifetime production period; **AFSP**: Age at first semen production; **ALSP**: Age at last semen production)

Expression of Growth Differentiation Factor-9 from buffalo follicular fluid – a marker gene for fecundity

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ABSTRACT

Growth factors synthesized from mammalian oocytes popularly known as Oocyte Secreted Factors (OSFs) play numerous role in ovarian folliculogenesis. Growth differentiation factor-9 (GDF-9) produced within the ovary plays an essential role during follicle maturation through their actions on granulosa cells, but their expression in follicular fluid has not been studied. The purpose of this study was to detect the temporal expression pattern of GDF-9 from the follicular fluid of buffalo ovary, which may be correlated with the oocytes and embryo quality. The sensitive messenger ribonucleic acid detection of GDF-9 from follicular fluid was determined by Reverse Transcriptase-Polymerase Chain Reaction using bovine oligonucleotide primers. Our finding showed the qualitative detection of GDF-9 mRNA transcripts from follicular fluid of buffalo ovary.

Key words: Buffalo, Follicular fluid, GDF-9 expression, RT-PCR

INTRODUCTION

Growth Differentiation Factor-9 (GDF-9), a prominent member of the Transforming Growth Factor-β(TGF-β) superfamily functions as paracrine factor in the regulation of granulosa cell proliferation and differentiation (Gilchrist *et al.*, 2006). Furthermore, GDF-9 is the first oocyte derived growth factor found to be indispensable in ovarian folliculogenesis and expressed throughout the development of the maturing follicle. Besides its activities in cumulus expansion, oocyte maturation and ovulation (Gui and Joyce, 2005; Yoshino *et al.*, 2006), italso play important roles during many steps of ovarian follicular development. GDF-9 involved in cell survival signaling (Orisaka *et al.*, 2006) and act as modulators of many other growth factors and endocrine hormones (Juengel *et al.*, 2004).

Given these results, GDF-9may be considered as a candidate gene for controlling ovulation rate in buffalo. Several studies have reported that supplementation of *in vitro* maturation media with FSH enhanced the cumulus

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expansion, nuclear maturation and cleavage rate of buffalo oocytes (Chauhan *et al*.,1996; Abdoon *et al*., 2001). Few other studies have reported the beneficial effects of including follicular fluid replacing hormones during *in vitro* maturation of buffalo oocytes (Chauhan *et al*., 1997).

In the ovaries, GDF-9 has been expressed in the oocytes of primordial follicles of sheep and cows (Bodensteiner *et al.*, 1999). The expression begins at the primary follicle stage in women (Aaltonen *et al.*, 1999), mice (Elvin *et al.*, 1999) and also in rats (Jaatinen *et al.*, 1999). GDF-9 mRNA expression has also been identified in extra-ovarian sites such as the pituitary, hypothalamus, placenta, testis and adrenal gland (Pennetier*et al*., 2004; Faure *et al.*, 2005; Farnworth *et al.*, 2006). Follicular fluid contains proteins, anticoagulants, enzymes, *etc.*, thereby providing the oocytes with a microenvironment which contains the necessary regulatory factors (Fortune, 1994). Since GDF-9 affect oocyte development during folliculogenesis, follicular fluid level of this oocyte secreted paracrine factor may be important for oocyte function and subsequent embryo quality. Although GDF-9 and its functions in mammals have captured increased attention in recent years, much remains to be learnt about this molecule in buffalo. There is a lack of information on the availability of this growth factor from follicular fluid. Therefore, this study was designed to investigate the expression of GDF-9 from follicular fluid of buffalo ovary.

MATERIALS AND METHODS

Buffalo ovaries were collected from a local abattoir at Perambur, Chennai within two hours of slaughter and washed five times in phosphate buffered saline (PBS) containing 100 IU/ml penicillin and 100 µg/ml streptomycin. The aspiration of non-atreticantral follicles (3-8 mm) was carried out using 18-gauge needle connected to a 10 ml disposable syringe (Fig. 1). The aspirated contents were centrifuged at 500g for 30 minutes in a cooling centrifuge at 4°C. After settling of follicular cells, supernatant part of follicular fluid was slowly aspirated and transferred into a fresh 1.5 ml microcentrifuge tube and then frozen at -80°C for RNA purification.

Total RNA was purified under RNase-free conditions at room temperature for each sample using Trizol Reagent (Invitrogen) according to the protocol of the manufacturer. In microcentrifuge tube, 250µl of cells free follicular fluid was lysed by the addition of 750µl Trizol followed by incubation at room temperature for 5 minutes. Then, 200µl of chloroform was added, vortexed for 5 seconds and incubated at room temperature for 5 minutes. The centrifugation at 12,000 rpm for 15 minutes at 4°C in cooling centrifuge separated the solution into an upper aqueous phase containing RNA and a lower phenol-containing organic phase. The upper aqueous phase was transferred to a clean, RNase-free eppendorf tube and again centrifuged at 12,000 rpm for 10 minutes at 4°C. Then, the pellet was washed with 1ml of 75% ice cold ethanol, subsequently centrifuged at 7500 rpm for 5 minutes at 4°C and ethanol was discarded. The microcentrifuge tube was air dried and suspended with 10µl of DEPC water. The purified total RNA was stored at 80°C. The quantity and purity of the RNA were determined by spectrophotometry.

The cDNA synthesis was carried out using Revert Aid M-MuLV Reverse Transcriptase Kit (Fermantas, USA)in a standard 20µl reaction mixture. One microgram oftotal RNA was used as template RNA for reverse transcription as per manufacturer's instructions. RT-PCR for GDF-9 was carried out by using the published (NCBI accession No: AB058416) forward (5' AGAAGCTGCTGAGGGTGTAAGATT3') and thereverse(5'AAGCAATTGAGCCATCAGGC3') primer sequences (Hosoe*et al.*, 2011) from bovine. These oligonucleotide primers amplified a fragment size of 401 base pair. The β-actin forward primer5'-GATGAGGCTCAGAGCAAGAGA-3'andreverse

primer 5'-TCGTCCCAGTTGGTGACGAT-3'(amplicon size 596 was used as the internal control for Polymerase Chain Reaction). The PCR programme comprised an initial denaturation at 95°C for 5 minutes, followed by denaturation at 95°C for 30 seconds, annealing at 52°C for 30 seconds, and extension at 72 °C for 1 minutes and final extension at 72 °C for 5 minutes. Each PCR was performed for 30 cycles for each sample. Products of the RT-PCR were separated by electrophoresis on 1.5% agarose gel and visualized by ethidium bromide staining.

RESULTS AND DISCUSSION

In this PCR study, the existence of GDF-9 mRNA expression in follicular fluid of buffalo ovary was observed. The presence of this fecundity gene from follicular fluid of buffalo was detected by using the reverse transcriptase PCR. Fig. 2 shows the PCR ampliconsof GDF-9 (NCBI accession No: AB058416) along with β-actin gene (NCBI accession No: BG689033) electrophoresed through 1.5% agarose gel.

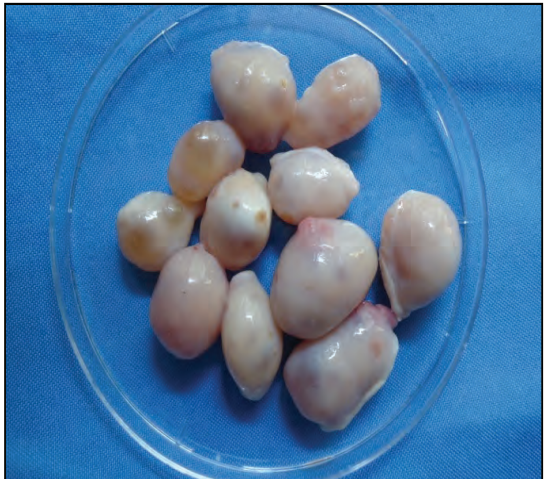

Fig.1. Picture showing ovaries of buffalo with follicles. Arrow mark showing fully grown good quality follicle from which the follicular fluid was collected.

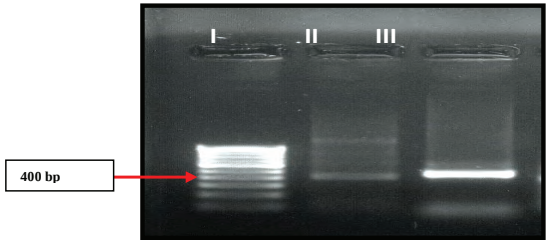

Fig. 2.Agarose gel showing PCR amplicons of GDF-9 (401 bp) and β-actin (endogenous control) from follicular fluid of buffalo ovary.Lane 1: 100bp Marker, Lane II: GDF-9 (401bp), Lane III: β-actin (596bp).

Folliculogenesis is a complex process dependent upon the intricate interplay of various growth factors and hormones. It is now well established that during ovarian folliculogenesis there is a dynamic interplay between the oocyte and the surrounding somatic cells that mutually influences growth and differentiation of the somatic granulosa cells and the oocyte (Gilchrist *et al.*, 2004). The members of the TGFβ superfamily influence a wide variety of growth and differentiation processes in a number of tissues and species. The newest member of this superfamily, GDF-9 appears to be no exception from this important function. Presumably, GDF-9 is the candidate gene for increasing the ovulation rate in sheep (McNatty *et al.*, 2003). The essential role of GDF-9 in fertility was demonstrated by targeted deletion of the GDF-9 gene in mice (Dong *et al.*, 1996). Long term immunization against GDF-9 in sheep disrupts early folliculogenesis and leads to the absence of normal follicles beyond the primary stage of development (Juengel *et al*., 2002). In addition, a naturally occurring mutation in this gene causes infertility in sheep (Hanrahan*et al.*, 2004). Positive staining for the GDF9 protein was identified in oocytes and granulosa cells in human ovarian samples (Oron*et al.*, 2010) and in buffalo oocytes (Kathirvel *et al.*, 2013).

In the present study, we have reported the expression of GDF-9 from the follicular fluid of buffalo ovary. There are no expression studies available to support the detection of GDF-9 gene from ovarian follicular fluid of buffalo. From previous ovarian expression studies, GDF-9 transcripts have been found to be localized in the oocytes from primordial follicles in cows and sheep (Bodensteiner *et al.*, 1999), whereas it is not found in primordial follicles of mice. These investigations suggest that expression pattern of GDF-9 differs between species. In goats, the polymerase chain reaction technique revealed the presence of GDF-9 mRNA in primordial, primary and secondary follicles, oocytes and granulosa cells of antral follicles (Silva *et al.*, 2004). Moreover it is reported earlier that the numbers of antral follicles per unit of ovarian mass and expression GDF9 serve as an important clue for higher prolificacy (Pramod*et al.*, 2013). Although results of our RT-PCR revealed the availability of GDF-9 expression from follicular fluid, the relative amount of mRNA transcripts of this gene need to be analysed through quantitative real time-PCR for further understanding the exact level of GDF-9 in follicular fluid of different category follicles. Additional studies on preantral follicles are needed to clarify the role of GDF9 as well as other growth factors.

In summary, the present study has demonstrated for the first time, GDF-9 expression from follicular fluid of buffalo ovary. This evidence of expression of GDF-9 in buffalo ovarian follicular fluid supports the effect of supplementation of buffalo follicular fluid during *in vitro* maturation of buffalo oocytes in improving the maturation rate. Moreover, the precise physiologic role of GDF-9 protein from follicular fluid in influencing oocyte needs further study.

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Performance of farmbred Jersey cattle under tropical climatic conditions of Tamil Nadu

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ABSTRACT

Data on production and reproduction performances of 373 Jersey cows born and reared at the Exotic Cattle Breeding Farm, Eachenkottai, Tamil Nadu, India, pertaining to 27 years were collected. They were analysed to study the effects of various non-genetic factors on milk production and reproduction traits. The least-squares means (± SE) for 305-day and total lactation milk yields for all the parities were 1491.6 ± 25.9 and 1560.9 ± 29.9 kg respectively. The averages for lactation length, service period, calving interval and dry period for all lactations were 303.1 ± 4.0, 177.0 ± 10.0, 461.0 ± 9.7 and 160.2 ± 9.7 days respectively. Years grouped into five periods had significant (P<0.01) influence on all the traits studied. Season of calving showed a significant (P<0.01) source of variation in milk yield traits and calving interval. Parity was found to influence 305-day milk yield, service period, dry period and calving interval significantly (P<0.01). The study revealed that the performance of the Jersey cattle was much lower than those maintained under high altitude conditions in Tamil Nadu and other places in India.

Key words: calving interval, dry period, heritability, milk yield, non-genetic factors

INTRODUCTION

As a policy the system, the cross breeding programme has been adopted to alter the genetic makeup of native zebu stock in the tropics. This tool has had India, transverse a long way in the global scenario of milk production. For cross breeding, bulls of Holstein Friesian, Jersey and other European milch breeds were introduced into India. Among them, the Jersey breed was preferred because of its perceived better adaptability to tropical climate. Importation of either bulls or frozen semen alone could not fulfill the needs of cross breeding programme in India. Hence, a programme of raising bulls within the country was made by establishing bull mother farms at different places. For this, the Government of Tamil Nadu, India imported a herd of 150 pregnant Jersey heifers in 1978 and 1979 in two batches from Australia to produce bulls of high genetic merit and to ensure regular supply of good quality semen. Although investigations have been carried out on Jersey cattle maintained in bull mother farms (Singh and Mishra, 1980; Sadana and Tripathi, 1986; Sreemannarayana and Rao, 1994; Pal *et al.*, 2002; Venkataramanan*et al*., 2007), a detailed study on Jersey cattle maintained under hot and humid climatic conditions of Tamil Nadu is lacking. Hence, an investigation on production and reproduction performances of the Jersey cattle

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born and bred on the farm has been made. This will be useful to understand the performance and the influence of various non-genetic factors affecting the economic traits of Jersey cattle.

MATERIALS AND METHODS

This study was based on the data pertaining to the progeny of imported Australian Jersey heifers and cows born and bred at Exotic Cattle Breeding Farm, Eachenkottai, Tamil Nadu, India from 1980 to 2006 (27 years). This farm is located in the east-coastal region of Tamil Nadu and the climate is generally hot, humid and tropical in nature. The Jersey cattle were housed in permanent sheds with open type ventilation and maintained under stall-fed conditions. Roughages in the farm of green fodder and paddy straw were provided. In addition, concentrate mixture was provided to all age groups as per the standard requirements. Cows were hand-milked twice daily in the morning and evening. Data on production and reproduction performances of farmbred Jersey cattle (1172 lactation records form 373 Jersey cows) were extracted from history and pedigree sheets. The traits studied were 305-day milk yield, lactation length, lactation milk yield, service period, calving interval and dry period. Period and season were the fixed environmental effects considered for all the traits. As the calvings were less in a year, year-season analysis was not done. To utilise all available data, the entire duration of the study was grouped into five periods and each year was classified into four seasons viz. winter (January to February), summer (March to May), south-west monsoon (June to September) and north-east monsoon (October to December). In addition, parity effect was also considered. First six parities were considered and parties six and above were lumped together as sixth parity. LSMLMW and MIXMDL PC-2 VERSION computer programme of Harvey (1990) was used to study the effect of various non-genetic factors. The model used for analysis was $Y_{ijkl} = \mu + P_i + S_j + O_k + e_{ijkl,}$ Where, Y_{ijkl} = the l^{th} observation in i^{th} period, j^{th} season and k^{th} parity, μ= overall mean when equal subclass frequencies exist, P_i = effect of i^{th} period ($_i$ =1 to 5), S_j = effect of j^{th} season ($_j$ =1 to 4), O_k = effect of k^{th} parity ($_k$=1 to 6) and e_{ijkl} = random errors NID (0, σ^2_e). The least-squares means were compared by Duncan's multiple range test.

RESULTS AND DISCUSSION

The least-squares means (± SE) for production traits are presented in Table 1. The milk yield in period 1 (1980-84) was significantly ($P<0.01$) more when compared to other periods. North-east monsoon and winter calvers were found to give the highest milk yield and they were different ($P<0.01$) from summer and south-west monsoon season calvers. Most of the 305-day milk yields reported for locally bred Jersey (Sreemannarayana and Rao, 1994; Pal *et al*., 2002; Ahmed *et al*., 2004; Venkataramanan, *et al*., 2007) was higher than the values observed in the present study. However, Singh and Mishra (1980) reported much lower value of 1176.2 ± 87.49 kg (n=17) for Jersey cattle maintained in Orissa, also a hot and humid region in India. A comparable value of 1399.10 kg was also reported by Sadana and Tripathi (1986) for Jersey cattle maintained at Palampur, Himachal Pradesh, a high altitude region in India. The significant influence of period and season of calving on 305-day milk yield and lactation milk yield in the present study corroborated with the findings of Chauhan (1990) and Murdia and Tripathi (1992). Parity had highly significant effect on 305-day milk yield and significant effect on lactation milk yield. The milk yields were lowest in first lactation and increased with advancement of lactation. Similar results were also reported for Jersey cows maintained in different places in India and Pakistan (Chauhan, 1990; Murdia and Tripathi, 1992; Ahmed *et al*.,2004; Venkataramanan*et al*., 2007). In general, the low productivity of *Bostaurus* in the tropics is attributable to the interaction of a complex group

of factors. Among these are the high atmospheric temperature and relative humidity, low content of essential nutrients in feeds, wide seasonal fluctuations in quantity and quality of feed and high incidence of disease (Mahadevan, 1966)

The least-squares means (± SE) for service period, calving interval and dry period are presented in Table 2. The service period observed was higher than the averages reported for Jersey cows by Jain *et al. (*1999) in India and Sattar*et al*. (2004) in Pakistan. Venkataramanan*et al*. (2007) reported that the calving interval of Jersey cows maintained at Nucleus Jersey and Stud Farm, located in highlands in Tamil Nadu as 416.5 ± 7.2 days and many other studies (Chauhan, 1990; Das *et al.,* 1990; Sattar*et al*., 2004) also indicated lower calving interval than that observed in the present study. However, comparable values were reported in India by Kar*et al*. (1987) and Jain *et al*. (2001). Gogoi*et al*. (1993) reported higher value of more than 530 days for Jersey cattle maintained in Assam, India and indicated the possible cause as the hot and humid climatic conditions. The dry period pooled over parities observed was higher than the value reported by Duc and Taneja (1984). The highly significant effect of period of calving on calving interval observed in the present study corroborated with the reports of Chauhan (1990) and Venkataramanan*et al*. (2007). Some of the studies (Das *et al.,* 1990; Venkataramanan*et al*., 2007) including the present one revealed that the mean calving interval for the first parity was higher than the records pooled over all parities.

The production performance of farmbred Jersey at Eachenkottai was generally distinctly lower than those observed in other parts of India. But the reproduction performance observed is comparable to earlier studies made in bull mother farms located at different places in India. Period and season of calving had highly significant effect on all the production traits studied, which indicated that the animals exposed to different environments during different years and seasons and this might be one of the reasons for poor production performance of the herd.

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Table 1.

Least-squares means (± SE) for different milk production traits of farmbred Jersey cows

Effect	n	305-day milk yield (kg)	Lactation length (days)	Lactation milk yield (kg)
Overall mean (μ)	**1172**	**1491.6 ± 25.9**	**303.1 ± 4.0**	**1560.9 ± 29.9**
Period of calving		**	**	**
P_1 (1980-84)	197	1729.5^{b}± 35.7	331.8^{c}± 5.5	1890.7^{b}± 41.2
P_2 (1985-89)	468	1451.7^{a}± 22.3	315.4^{bcd} ± 3.5	1494.9^{a}± 25.7
P_3 (1990-94)	418	1538.1^{a}± 23.0	304.2^{bd}± 3.6	1579.2^{a} ± 26.5
P_4 (1995-99)	69	1400.6^{a}± 54.5	264.2^{a}± 8.5	1415.8^{a}± 63.0
P_5 (2000-04)	20	1338.3^{a}± 98.3	300.4^{ad}± 15.3	1423.8^{a} ± 113.5
Season of calving		**	**	**
Winter (Jan. – Feb.)	156	1566.5^{b}± 42.6	313.2^{b}± 6.6	1629.8^{bc}± 49.2
Summer (Mar. - May)	305	1383.2^{a}± 32.3	289.7^{a}± 5.0	1453.7^{a}± 37.3
South-west monsoon (Jun. – Sep.)	329	1447.0^{a}± 32.7	301.6^{ab}± 5.1	1523.2^{ac}± 37.8
North-east monsoon (Oct.-Dec.)	382	1570.0^{b}± 32.0	308.2^{b}± 5.0	1636.9^{b}± 36.9
Parity		**		*
First	373	1396.8^{a}± 30.0	299.1 ± 4.7	1469.5^{a}± 35.0
Second	284	1448.7^{a}± 33.5	304.0 ± 5.2	1511.2^{ab}± 38.7
Third	210	1496.5^{a}± 36.7	311.4 ± 5.7	1563.6^{b}± 42.4
Fourth	144	1511.3^{a}± 42.3	303.6 ± 6.6	1597.2^{b}± 48.8
Fifth	87	1537.7^{ab}± 52.4	298.2 ± 8.1	1584.5^{b}± 60.5
Sixth and above	74	1558.8^{b}± 55.5	302.9 ± 8.6	1639.3^{b}± 64.1

n= number of observations. * P<0.05, ** P<0.01.

Means bearing same superscript do not differ significantly.

Table 2.

Least-squares means (± SE) for different reproduction traits (days) of farmbred Jersey cows

Effect	n	Service period	n	Calving interval	n	Dry period
Overall mean (μ)	**829**	**177.0 ± 10.0**	**878**	**461.0 ± 9.7**	**861**	**160.2 ± 9.7**
Period of calving		**		**		**
P_1 (1980-84)	156	170.3^{ab}± 11.4	178	459.8^{bc}± 11.2	168	125.9^{a}± 11.5
P_2 (1985-89)	355	169.1^{a}± 7.3	372	444.6^{ac}± 7.4	366	129.8^{a}± 7.5
P_3 (1990-94)	278	145.3^{a}± 7.9	286	422.2^{a}± 8.1	283	117.7^{a}± 8.2
P_4 (1995-99)	30	235.9^{b}± 22.8	30	515.2^{bd}± 23.5	32	261.7^{bc}± 22.9
P_5 (2000-04)	10	164.4^{a}± 38.9	12	463.4^{acd}± 36.6	12	165.8^{ac}± 36.8
Season of calving				*		
Winter (Jan. – Feb.)	106	199.3 ± 15.3	111	487.2^{b}± 15.1	113	177.7 ± 15.1
Summer (Mar. - May)	208	174.8 ± 11.8	218	460.4^{ab}± 11.7	216	167.1 ± 11.7
South-west monsoon (Jun. – Sep.)	235	170.1 ± 11.9	253	451.1^{a}± 11.7	243	151.9 ± 11.8
North-east monsoon (Oct.-Dec.)	280	163.8 ± 11.9	296	445.5^{a} ± 11.6	289	144.1 ± 11.7
Parity		**		**		**
First	260	208.0^{bd} ± 11.4	288	496.5^{b}± 11.0	283	201.6^{b}± 11.0
Second	205	203.7^{bc} ± 12.0	215	486.0^{ab}± 11.8	210	184.6^{bc}± 11.9
Third	155	183.8^{ab} ± 13.3	159	466.9^{ab} ± 13.1	157	157.6^{ac}± 13.2
Fourth	102	164.2^{ac}± 15.1	106	450.2^{a}± 15.0	104	143.5^{a}± 15.2
Fifth	60	157.3^{acd}± 17.8	61	437.9^{a}± 18.0	60	136.4^{a}± 18.2
Sixth and above	47	145.0^{a}± 20.0	49	428.7^{a}± 20.1	47	137.9^{a}± 20.5

n= number of observations. * P<0.05, ** P<0.01.

Means bearing same superscript do not differ significantly

Adoption and Perceived Effectiveness of Traditional practices to mitigate human-wild pig conflict situations

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ABSTRACT

Human–wild pig conflict is one of the main threats to farmers as wild pig destroys the growing crops completely. Krishnagiri district of Tamil Nadu was purposefully selected for the study as it ranked first in human-wild pig conflict incidents in Tamil Nadu. Farmers who had at least one wildlife conflict incidence in their lifetime were selected for this study during 2015-16 on adoption and effectiveness of traditional practices to manage human-wild pig conflict situations. Sixty participants were selected using the snow ball sampling and data were collected using semistructured interviews, complemented by free listing techniques, nonspecific prompting and reading back. A total number of nine traditional practices were identified and found that they were adopted at various levels. Further, boundary clearing, using metal cow bells and using shining tapes (100 %) were found to be most effective traditional method followed by fireworks/ crackers (75 %), noise making (72.2 %) and scarecrows (69.6 %). Although encouraging, these results require more widespread testing and demonstration to ensure their effectiveness at broader scales.

Keywords: Human-pig conflict, traditional practices, metal cow bells, shining tapes, scarecrows, fireworks

INTRODUCTION

Wild pig (*Susscrofa)* is the most widely distributed large mammal and distributed in North Africa, Europe and Asia (Rao*et al.,* 2015). The wild pig population is increasing drastically not only due to its prolificacy in breeding but also depletion in the head counts of its predators such as tiger, leopard, wild dogs, wolf and jackals (Khan *et al.,* 2019). Overabundances of wild pig population, scarcity of food and shrinking natural habitats have compelled the wild pigs to intrude the forest fringe villages and farms. Cutting of forest trees for

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farming and industrial activities often accelerate the humans and wild animals conflicts.

The farmers in such areas have to bearconsiderable economic loss (Fig.1).Therefore, the farmers resort to different traditional methods to mitigate the intrusion of wild pigs into their farming land. Hence a study was carried outto identify the traditional practices followed by the farmers and also find adoption and perceived effectiveness.

MATERIALS AND METHODS

Among the 38 districts of Tamil Nadu state, this study on adoption and perceived effectiveness of traditional practices to mitigate human-wild pig conflict situations was purposively carried out in Krishnagiri district of Tamil Nadu state during 2015-2016 due to the high incidence of human-wild pig (210 incidents during 2014-15) conflict on the basis of data from Tamil Nadu Forest Department. From the four forest zone blocks of Krishnagiri district, two blocks viz., Denkanikottai and Thally were randomly selected. From these two blocks, six villages were also chosen randomly. Sixty respondents (ten farmers per village) were selected using the snowball technique and data were collected using semi structured interview schedule, complemented by free listing techniques, nonspecific prompting, and reading back. The data was analysed using average and percentage.

RESULTS AND DISCUSSION

A total number of nine traditional practices were identified that include noise-making, fire/ smoke producing, manual guarding, traditional fences, scarecrows (Fig.2), boundary clearing, fireworks/crackers, metal cow bells and shining tapes. The results in Table 1 revealed that among the nine chosen traditional methods, fireworks/ crackers (66.7 %) ranked first in the adoption of traditional practice to mitigate human-wild pig conflict.

About 63 per cent of the respondents of the study area were manually guarding the crop fields during the harvest time to drive away the intruding wild pig. Similar strategy was followed by the farmers of Mazowe District of Mashonal and Central Province, Zimbabwe (Nyika, 2017). During certain period of high crop vulnerability, mostly male members of the family would take the turns to guard the field crops. They used the different methods to cope with human-wild pig conflict. Farmers tied the metal cow bells and hung them at fence to act as an alarm if a wild pig tried to break through the perimeter fencing. Similar technique was recorded by Graham and Ochieng (2008) to mitigate the human-elephant conflict by the farmers in Laikipia District, Kenya.

Table 1. Adoption and perceived effectiveness of traditional practices to mitigate human-wild pig conflict situations

n=60

S. No.	Traditional practices	Adopters		Non-adopters		Effective		Ineffective	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	Noise-making	36	60.0	24	40.0	26	72.2	10	27.8
2	Fire/Smoke	22	36.7	38	63.3	9	40.9	13	59.1

3	Manual Guarding	38	63.3	22	36.7	22	57.9	16	42.1
4	Traditional fences	4	6.7	56	93.3	-	-	4	100.0
5	Scarecrows	23	38.3	37	61.7	16	69.6	7	30.4
6	Boundary Clearing	4	6.7	56	93.3	4	100.0	-	-
7	Fireworks/ Crackers	40	66.7	20	33.3	30	75.0	10	25.0
8	Metal cow bells	4	6.7	56	93.3	4	100.0	-	-
9	Shining tapes	6	10.0	54	90.0	6	100.0	-	-

Use of shining tapes like video/audio tapes had been observed as well established fact that wild pigs were afraid of shining materials which reflect light from far away. Due to this reason, farmers tie audio and video tapes roll all around the crop fields with wooden sticks. During daytime, the tapes glare due to scorching sunlight and in night, they reflect in dark that made the wild pigs frightened to keep them away from the agricultural fields. This is in accordance with the findings of Meena *et al.* (2014) who proved the shining tapes were very successful technique to frighten the blue bulls in Rajsamand district, Rajasthan, India. Moreover, there is a need to develop appropriate extension mix for disseminating the locally relevant ITK through vernacular language targeting the resource poor farm families (Ponnusamy *et al*., 2017).

Even though using fireworks/crackers ranked first, only 75 per cent of the farmers perceived it to be effective. But cent per cent efficacy was recorded by the farmers practicing boundary clearing, metal cow bells, and shining tapes though these were adopted by 6.7 per cent and 10 per cent farmers respectively. The farmers created noises by various means to frighten the intruding wild pig herd. Some of the farmers also released dogs during encounter with wild animals. Rao*et al.* (2015) used castor (*Ricinuscommunis*) as a barrier to reduce the damage caused by wild pig conducted at Agricultural Research Station, Tandur (Telangana state) in the Maize (*Zea mays*) crop. In addition to this, Naik and Basavadarshan (2020) used color sarees to drive the intruding wild pigs and found to be effective at Arjunahalli and surrounding villages which were in the vicinity of the forest, KanakapuraTaluk, and Ramanagara District of Karnataka State.

The losses created by various wild animals to the farmers are given in the table 2. This table clearly depicted that majority (48.30 %) of the elephant conflict respondents experienced losses which was below Rs.10,000 followed by 23.30 per cent of them suffered losses between Rs.25,001- 50,000. The major losses created by the wild pigs on the farmers were recorded in Paddy fields followed by *Ragi*(finger millet). McKee*et al.* (2020) estimated crop loss due to feral swine of $272 million for the surveyed set of crops in 12 states in United States.

Table 2. Distribution oflosses to crops ofhuman wild pig conflict affected farmers

(N=60)

S. No.	Losses to crops (Rs.)	Number of farmers (Percentage)
1	Below 10000	29 (48.30%)
2	10001-25000	13 (21.70%)
3	25001-50000	14 (23.30%)
4	Above 50000	4(6.70%)

CONCLUSION

Crop depredation by wild pigs is enormous. Hence the farmers use different traditional technologies to mitigate the human-wild pig conflict. The results of the present study indicate that among the different traditional methods used to mitigate Human wild pig conflict, fireworks/ cracker, manual guarding and noise making were highly adopted than rest of the traditional methods. But boundary clearing, metal cow bells and shining tapes were found to be highly effective in reducing the wild boar followed by noise making, fireworks/ crackers and scarecrowsaround the crop was promising. Hence proper educational programme may be conducted among the farmers of affected areato popularize the effective traditional methods to mitigate human wild pig conflict through training. Although encouraging, these results require more widespread testing and demonstration to ensure their effectiveness at broader scales.

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Fig.1 Wild pig Trampled field

Fig.2 Scarecrows to drive out intruding wild pigs

Energy consumption pattern in manufacturing of different types of broiler feeds

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ABSTRACT

The present study was carried out to determine the specific energy consumption pattern in the manufacturing of different type of broiler feeds with different process conditions and thereby analyze the gaps between the benchmarking and actual energy usage pattern. The study was conducted in three commercial feed plants located at different locations. This was achieved by conducting energy analysis for the specific energy consumption for different type of the broiler feeds. The actual consumption was recorded from the electricity board department's energy meter readings. The results indicated that the gap between actual consumption and bench marking was lesser at one plant whilst, it was considerably higher at other two plants. The gap was observed to be higher in the pre-starter feed and lesser in the finisher pellet feed. The gap between actual power consumption and benchmarking observed for pre-starter feeds at different locations viz., Muzaffarpur, Kanpur and Ambala was 2.70, 2.43 and 0.85 kwh units respectively. The gap analysis for starter feed was 1.71, 1.46 and 0.59 kwh units and for finisher feed 1.37, 1.81 and 0.92 kwh units respectively. The cost saving per metric tonne of feed ranged from Rs. 16.00 to Rs. 22.00. Among the three feed manufacturing plants, the gap between bench marking and actual power consumption was very minimal at Ambala plant due to better production efficiency. From the boiler's fuel cost point of view, coal was found to be cheaper than wood due to its high calorific value and hence it was suggested to replace fire wood with coal at Ambala plant for further improvement of fuel efficiency. The present findings also revealed that the timely replacement of press roller of pellet mill and reduction in pellet fines recycling leads to better efficiency and cost control.

Key words: energy efficiency, boiler fuel, coal, wood, fuel efficiency

INTRODUCTION

Feed milling industry is one of the most energy consuming industries in the world. Like capital, labor and materials, energy is also one of the major production factors which are used to produce final product. In economical terms, energy is demand-derived goods and can be regarded as intermediate good whose demand depends on the demand of final product. Electricity is the main energy source for these feed mills which is imported from the state electricity board grids. Electricity is

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used to run motors, pumps, blowers, conveyors, fans, lights, etc. The variations in the consumption rate of energy through the use of utilities during processing must also be accounted for final cost of the finished product. The feed milling consumes significant quantity of fuels and electricity. The major energy consuming equipments in the feed milling units are; pellet mill, hammer mill, boiler and steam distribution units, blowers, pumps, conveyers, elevators, motors, transmission systems, weighing, *etc*. Energy, its utilization and conservation, may be the greatest challenge facing management in the feed industry today and in the years ahead. All forms of energy are increasing in cost and diminishing in supply; yet effective energy management, or conservation, can reduce the cost impact and make better use of available energy supplies. As energy is used more effectively, product costs can be reduced and profits improved.

Energy is one of the most critical input resources in the manufacturing industries. In most cases, energy cost outweighs the costs of other resources such as raw material, labors, depreciation and maintenance **(**Fadare, 2003). Energy is one of the most important material bases for the economic growth and social development of a country or region. Scientific forecasts and analysis of energy consumption will be of great importance for the planning of energy strategies and policies. Nowadays, energy usage in agriculture has been intensified in response to continued growth of human population, tendency for an overall improved standard of living and limited supply of arable land; thus, the farmers use their inputs in excess and inefficiently, particularly when the inputs have low price or are available in plenty. The enhancement of energy efficiency not only helps in improving competitiveness through cost reduction, but also results in minimized energy-related environmental pollution, thus positively contributing towards sustainable development (Kizilaslan, 2009 and Ghorbani*et. al.*, 2010).

Improvement of energy efficiency in our facility improves the bottom line; increases productivity and market competitiveness; lessens the impact and protects the business from fluctuations in energy prices and reduces carbon emission and stay ahead of government regulations.

Though, wide variety of technologies has been evolved for efficient use of energy for various equipments of feed mills, so far, only a few have improved their energy efficiency levels. Most of the feed mills use old and locally available technologies and are also completely dependent on locally available technical personnel. In this pretext the present investigation was carried out at three different commercial feed mills located at Muzaffarpur (Bihar), Ambala (Haryana) and Kanpur (UP) to determine energy consumption pattern during different stages of feed manufacturing process for each type of feed viz., pre-starter, starter and finisher feed with different type boilers and work out the economic impact of energy utilization on feed production.

MATERIALS AND METHODS

The determination of the energy consumption in manufacturing of different types of broiler feeds (crumbs and pellets), was the main target of this study. This was achieved by determining the energy consumed in each stage of processing to assess the most consumable stage in the different types of feed. The bench marking study is done for specific energy consumptions of major sections in the feed milling process *viz.*, intake, batching & grinding, pelleting and boiler and other utilities.

Energy benchmarking for industry is a process in which the energy performance of an individual plant or an entire sector of similar plants is compared against a common metric that represents 'standard' or 'optimal' performance. As a benchmarking standard "Specific Energy Consumption" energy analysis was conducted by

measuring running amps of the individual motor load. Load factor of each motor is calculated. From the input Volts and measured current (amps), individual motor power consumption unit has been calculated. The benchmarking energy analysis was studied for all of three plants for different types of feeds of prestarter, starter and finisher feeds. Actual energy consumption data was taken from the electricity meter installed in the feed mill.

Methodology Used

Electrical power consumption was estimated from the measured electric current and voltage values and estimated according to Kurt (l979)as follows from equation:

The amount electricity (kwh) used to produce one tonne of feed (kwh/T) is calculated as follows as specific energy consumption of the individual motor by using the following formula :

$$\text{Power (kwh)} = \frac{\text{A x voltage x } \sqrt{3} \text{ x power factor}}{1000} \quad \text{MT/ Hour}$$

(power factor has been taken as 0.95)

Specific energy consumption in terms of kwh \ MT of feed was calculated for Pre-Starter, Starter and Finisher feed and the benchmarking data has been arrived under standard process conditions. The specific energy consumption bench mark data was compared with the actual energy consumption data which were being recorded from energy meter installed by the electricity department.

Method of Motor Load measurement

To estimate the motor load factor power measurement was carried out in induction motor as a part of work during the detailed energy studies. The power measurements were used to calculate the actual load factor of induction motor at site conditions. The power measurements were done with the help of a Class 1 accuracy clamp-on power meter.

Actual power consumption was arrived from the data collected from the EB meter installed at the respective plants and it was calculated as per MT of prestarter, starter and finisher feed.

Boiler Fuel Consumption

Coal is being used for the boilers located at Muzaffarpur and Kanpur and wood is used at the Ambala plant's boiler unit. Fuel usage per MT of feed was calculated from the daily consumption record.

$$\text{Fuel Consumption per MT of feed} = \frac{\text{Total Consumption in Kgs}}{\text{Qty of feed produced in MT}}$$

Table 1. Technical specifications of boiler unit at three feed plants

S.No.	Particular	Details		
		Muzaffarpur	**Kanpur**	**Ambala**
1	Firm Name	Ugraya foods and feeds pvt. Ltd.	Prime avian feeds pvt. Ltd.	Ugraya foods and feeds pvt. Ltd.
2	Type of Boiler	Horizontal Multi Tubular Fully Wet back Three pass smoke tube Boiler	Horizontal Multi Tubular Fully Wet back Three pass smoke tube Boiler	Horizontal Multi Tubular Fully Wet back Three pass smoke tube Boiler

3	Design, Fabrication	IBR 1950 with latest Amendments. inspection & testing code	IBR 1950 with latest Amendments. inspection & testing code	IBR 1950 with latest Amendments. inspection & testing code
4	Model	IFB-20D -THERMAX MAKE	IFB-10D -THERMAX MAKE	IFB-10D -THERMAX MAKE
5	Evaporation Capacity	2000 Kg/hr (F&A 100°C)	1000 Kg/hr (F&A 100°C)	1000 Kg/hr (F&A 100°C)
6	Max. Working Pressure	10.54 Kg/cm2(g) (Safety valve set off)	10.54 Kg/cm2(g) (Safety valve set off)	10.54 Kg/cm2 (g) (Safety valve set off)
7	Efficiency	72%	72%	72%
8	Fuel	Coal	Coal	wood
9	Gross Calorific Value	3500 kCal/kg	4500 kcal/kg	4500 kCal/kg
10	Mode of combustion	Mechanical Draught	Mechanical Draught	Mechanical Draught
	Type of feeding	Manually through fire door	Manually through fire door	Manually through fire door

RESULTS AND DISCUSSION

The process condition under which energy consumption study was conducted is given in Table 2. The pelleting process conditions are different from one another at each plant. Conditioner design is different from one another at all of the three plants and the moisture addition is maintained in the range of 2.0- 2.5% by adjusting steam flow valves. Different hole diameter and thickness of the die has been used at all the three plants. It has been observed that there is variance in the electrical consumption at all the three plants.

The comparative details of benchmarking of specific energy consumption analysis per MT of feed of pre-starter crumbs (PSC), starter crumbs (SC) and finisher pellet (FP), produced at muzaffarpur, kanpur and ambala respectively are depicted in Table 3. The specific energy consumption benchmarking analysis was done for the different processes such as intake, batching and grinding, pelleting, boiler and other utilities. From the individual process study values, total power consumption in kwh units were calculated. The actual power consumption units were calculated from the energy meter's initial and final readings. From the total benchmarking and actual power consumption data, the gaps were identified. The gap between benchmarking and actual observed was more at muzaffarpur plant and lesser gap was observed at ambala plant. The electrical energy utilization efficiency was found to be better at ambala plant and less efficient at muzaffarpur plant, followed by kanpur plant. Overall, high cost impact per MT of feed was observed at Kanpur due to high power cost. The potential cost saving per month by considering average production volume at respective plants has been calculated as Rs. 79,459 at muzaffarpur, Rs. 21,091 at kanpur and Rs. 17,158 at ambala.

Table 2. Process design Variables

S.No	Pelleting Variables	Plant		
		Ambala	**Kanpur**	**Muzaffarpur**
1	Ground Particle Size passing on 0.71mm (%)	65-70	65-70	65-70
2	Moisture Addition at Conditioner (%)	2.0	2.5	2.0
3	Added Fat (%)	0.5 -0.9	0.5 -0.9	0.5 -0.9
4	Steam Pipe Size from Boiler (NB)	40	40	50
5	Die Hole diameter (mm)	3.2	2.8	3
5	Pellet Die L/D Ratio	01:10.5	1:12	1:13
6	Die Material	Chrome	Chrome	Chrome
7	Retention Time at Conditioner (Seconds)	10	15	30
8	Conditioner Type	Two Stage	Single	Two Stage
9	Moisture Addition at the Conditioner (%)	2.00- 2.5	1.8-2.2	2.0- 2.5
10	Conditioner Length (mt)	2.0	3.0	2.5
11	Retention time (Seconds)	20	10	30
12	Steam Pressure (Kg/cm2) at PRV	2.5	2.5	2.5

The boiler fuel consumption pattern is presented in Table 4. Fuel consumption quantity per MT of feed was calculated from the boiler operators log book. The fuel consumption usage per MT of feed was arrived. Coal was used as a fuel at two boilers at Muzaffarpur and Kanpur and fire wood was used at Ambala. From the fuel consumption volume and actual fuel price, the fuel cost per MT of feed was calculated as Rs 94.15 at Ambala, Rs 73.98 at Kanpur and Rs 88.57 at Muzaffarpur. Coal has been identified as cheaper source of fuel as compared to firewood and up to Rs 20 can be saved per MT of feed, if coal is used as a fuel.

Table 3. Data on boiler design and operation for three different feed plants

S.No	Description	Plant Locations		
		Ambala	**Kanpur**	**Muzaffarpur**
1	Make	Thermax	Thermax	Thermax
2	Model. No	IFB-10D	IFB-10D	IFB-20D
3	Efficiency (%)	73	73	78
3	No of Passes	Three	Three	Three
4	Steam Generation Capacity (Kgs/ Hr)	1000	1000	2000
5	Year of installation	2012	2014	2013
6	Design Pressure (Kg/cm2)	10.54	10.54	10.54
7	Max Working Steam Pressure (Kg/cm2)	10.5	10.5	10.5

8	Operational Pressure (Kgs/cm2)	8.5	9	8.5
6	ID (Induced Draft Fan)	Available	Available	Available
7	FD (Forced Draft Fan	Available	Available	Available
8	Water Pre heater	Available	Available	Available
10	Fuel Type Used	Wood	Coal	Coal
11	Net Calorific Value (Kcal /kg)	3500	4500	4500
12	Production per hour (MT)	10	10	20
13	Fuel Consumption (Kgs) /Hr	207.13	82.2	208.4
14	Fuel Consumption (Kgs) / MT of feed	18.83	8.22	10.42
15	Fuel Cost per kg (Rs)	5	9	8.5
16	Fuel cost per MT of feed (Rs)	94.15	73.98	88.57

Table 4. Data on Electricity Consumption Analysis - Benchmarking of specific energy consumption Vs Actual Consumption Units

S. NO	Particulars	Muzaffarpur			KANPUR			Ambala		
		PSC	SC	FP	PSC	SC	FP	PSC	SC	FP
1	Intake Bench Marking Units (kwh)	1.75	1.75	1.75	1.36	1.36	1.36	1.11	1.11	1.11
2	Batching & Grinding Bench marking units (kwh)	9.25	9.25	9.25	7.23	7.23	7.23	7.68	7.68	7.68
3	Pelleting bench marking units (kwh)	20.14	18.13	15.47	20.54	20.5	17.46	18.2	16.5	15.17
4	Boiler & other utilities benchmarking units (kwh)	1.16	1.16	1.16	1.44	1.44	1.44	1.12	1.12	1.12
5	Total Benchmarking Units (kwh)	32.3	30.29	27.63	30.57	30.5	27.49	28.2	26.4	25.1
6	Actual Power Consumption Units (kwh)	35	32	29	33	32	29.3	29	27	26
7	Gap between standard and Actual (kwh)	2.7	1.71	1.37	2.43	1.46	1.81	0.85	0.59	0.92
8	KWH Cost (Rs) /Unit	6.15	6.15	6.15	9.06	9.06	9.06	8.37	8.37	8.37
9	Cost impact per MT of feed (Rs)	16.61	10.52	8.43	22.02	13.23	16.4	7.11	4.94	7.7
10	Average Production Qty .Month (MTs)	1090	4048	2230	162	762	454	296	946	1348
11	Cost Impact per month (Rs)	18099	42571	18789	3567.2	10081	7445	2106	4672	10380
12	Total potential Cost Savings / Month (Rs)	79459			21091			17158		

PSC – Prestarter crumbles; SC – Starter crumbles; FP – Finisher pellets

The actual power consumption units (kwh) for pre-starter feed were 35, 33 and 29 at Muzaffarpur, Kanpur and Ambala plants respectively which is of 2.7, 2.45 and 0.85 more than bench marked specific energy consumption units. For pre-starter feed, power consumption was high at muzaffarpur plant and lower at ambala plant. For Starter feed, the actual power consumption were 32,32 and 27kwh, which is of 1.71, 1.46 and 0.59 units more than the bench marked specific energy consumption units at muzaffarpur, kanpur and ambala plants respectively. For finisher feed, the actual power consumption were 29, 29.3 and 26kwh, which is of 1.37, 1.81 and 0.92 units more than the bench marked specific energy consumption units at muzaffarpur, kanpur and ambala plants respectively. From the boiler's fuel consumption study, coal consumption was 8.22 Kg and 10.42 kg/MT of feed and fuel cost was Rs 73.98 and Rs 88.57/MT for Kanpur and Muzaffarpur boilers respectively. Fire wood was used at Ambala boiler plant. The fuel consumption per MT of feed was 18.83 kg and cost per MT of feed was Rs. 94.15.

Kilborn *et. al.*(1982) found that the total specific milling energy ranged from 46 $kJ \cdot kg^{-1}$ for soft wheat cultivars to 124 $kJ \cdot kg^{-1}$ for durum wheat. Dziki, (2008)reported that the specific grinding energy of uncrushed kernels ranged from 72.3 to 146.7 $kJ \cdot kg^{-1}$ and from 67.0 to 114.4 $kJ \cdot kg^{-1}$ for Turnia and Slade, respectively. The crushing caused a decrease of specific grinding energy in both cultivars. The total specific grinding energy of crushed kernels (the sum of crushing energy and grinding energy) ranged from 47.6 to 100.5 $kJ \cdot kg^{-1}$ and from 44.6 to 85.3 $kJ \cdot kg^{-1}$ for hard and soft wheat, respectively. Dziki, (2008)presented the results concerning the influence of grain mechanical properties on wheat grinding energy requirements. The investigations were carried out on 10 wheat varieties (grain moisture was 15%). The results showed that the specific grinding energy ranged from 22 to 37 $kJ.kg^{-1}$. The grinding efficiency index ranged from 0.215 to 0.342 $m^2.kg^{-1}$.

Kulig and Laskowski (2005) reported that an increase in fat concentration in feed material from 2 to 5.5% reduces energy consumption during pelleting by 30%. In general, the specific energy required for pelleting (i.e., energy consumed by the pellet mill motor) may range from 4 to 40 kwh/t (Stevens, 1987; Israelsen*et. al.,* 1981 and Tabil *et. al.,* 1997). In addition, steam conditioning/ preheating the feed may require considerable energy. For example, Skoch *et. al.* (1981) estimated that steam conditioning to increase the temperature from 27 to 80°C consumed about 26 kwh/t. Steam addition in pelleting operations improves pellet durability. Added steam provides heat and moisture and it also helps to reduce energy consumption during pelleting.

There is no known report in the literature on the energy requirements of feed processing operations. Such information is vital so as to enable the management of this industry to develop strategies for better control of their production operations and modify areas of waste. It will also enable the management to properly appraise their energy consumption for effective planning of production network.

From the electric energy consumption study, it has been observed that ambala plant was more energy efficient as the gap between actual power consumption and bench marked data is lower which was highest at muzaffarpur followed by kanpur plant. The present study revealed that the power consumption was higher at muzaffarpur due to lack of efficient pelleting output followed by kanpur plant due to installation of high capacity motor. If the actual energy efficiency is achieved to benchmarking data, the power cost per MT of feed can be saved to the tune of Rs 16.61, 10.52 and 8.43 for Pre-starter, starter and finisher feed respectively at muzaffarpur, Rs 22.02, 13.23 and 4.94 at kanpur and Rs 8.43, 7.11 and 7.7 at ambala plant .The overall cost saving per month can be Rs 79,459, Rs 21,091 and Rs 17,158 at muzaffarpur,

kanpur and ambala plants respectively. If energy is used more effectively, product costs can be reduced and profits improved.

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Fatal secondary septic peritonitis associated with multiple renal and splenic infarcts in Lhasa Apso dog

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ABSTRACT

An eight year old male Lhasa Apso dog was presented for necropsy with the history of persistent vomition, anorexia,lethargy, dehydration and abdominal distension.Blood picture revealed marked neutrophilic leukocytosis along with left shift. Necropsy examination revealed the presence of secondary septic peritonitis and multiple renal / splenic infarcts. Histologically, perforative/haemorrhagic enteritis, renal infarcts with diffuse glomerular / tubular necrosis of coagulative type and splenic infarction with occluded artery containing bacterial thrombo-emboli were confirmed. Secondary peritonitis has been observed to be a frequent complication associated with perforation of the intestine.These fatal complications of septic peritonitis present a therapeutic challenge and needs prompt veterinary care and treatment.

key words: Dog, Renal infarcts, splenic infarcts, septic peritonitis

Peritonitis in animals may occur as a primary disorder or may be secondary to other pathophysiological conditions. A variety of agents can cause peritonitis resulting in several clinical symptoms, disease progression and adverse effects. The etiologiesrange from viral to bacterial to parasitic to physical agents and organrupture (Zachary, 2012). Gastrointestinal ulcers account for nearly 24% to 35% of gastro-intestinal tract associated peritonitis (Greenfield and Walshaw, 1987).Peritonitis can be classified as acute or chronic depending on the duration; septic or non-septic depending on the infectious nature of the causative agent; local or diffuse depending on the area involved and adhesive or exudative depending on the type of inflammatory product. The incidence of primary peritonitis is lesser than that of secondary peritonitis and can be infectious or idiopathic. In case of primary peritonitis caused by pathogenic organisms, the organisms spread *via* blood to the peritoneal cavity.

Primary peritonitis is rare in healthy dogs and is often observed in immune compromised animals. In case of secondary peritonitis, the peritoneal cavity becomes contaminated

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with infectious agents *via* translocation or penetration through the wound or leakage from the gastrointestinal tract (most common cause) or through leakage from other infected visceral organs (eg, hepatic/ splenic abscess, inflamed bladder/ uterus, etc.). Pathogenic organisms frequently isolated are Nocardia, Mycobacterium, *Haemophilusparasuis*, *etc*. Perforations in the abdomen or wound dehiscence can cause laceration of the visceral organs, followed by translocation of extraneous substances and infectious agents into the peritoneal cavity. Migration of endoparasites can also cause leakage of the ingesta leading to septic peritonitis. The gross and microscopic features of a case of fatal secondary septic peritonitis in a LhasoApso dog along with splenic and renal infarcts as its complicationare described in the present communication.

An eight year old male Lhasa Apsodog was admitted with the history of persistent vomition, anorexia and lethargy for one week. The dog had injected mucous membranes, sunken eyes with marked dehydration and exhibited abdominal distension and localised pain on cranial abdominal palpation. Blood picture revealed marked leukocytosis with neutrophilia and shift to left. The animal collapsed during clinical examination.

A detailed post-mortem examination was conducted and representative tissue samples from liver, lungs, kidneys, spleen, stomach and intestines were collected in 10% neutral buffered formalin. The tissue samples were processed for histopathological studies employing paraffin embedding technique. Sections of 3-5mm thick were prepared and stained with hematoxylin and eosin (H&E) following standard procedures.

At necropsy, the abdominal cavity contained abundance of sero-sanguinous fluid, fibrin deposits and undigested feed contents (Fig.1). The serosal surface of the intestine and the mesentery showed multifocal, randomly distributed areas of marked congestion and haemorrhage. Three perforations measuring around 1-2 cm diameter with irregular haemorrhagic borders were present in the duodenal segment (Fig.2). Kidneys were moderately shrunken and had multiple irregular depressed areas with fibrin deposits. The cut surface appeared diffusely congested and had multiple, well demarcated, yellowish white wedge shaped areas of necrosis surrounded by thin zones of congestion (Fig.3). The broader end of spleen appeared markedly enlarged, oedematous, congested and haemorrhagic with discrete red black wedge shaped foci filled with blood and adherent fibrin deposits (Fig.4). Cut surface of spleen showed well demarcated zones of necrosis and haemorrhage.

On histopathological examination, intestinal segment adjacent to the site of perforation showed marked necrosis and extensive areas of congestion and haemorrhages in the mucosa/ sub-mucosa. The renalinfarcts were characterized by diffuse glomerular/ tubular necrosis with the preservation of architecture (coagulative necrosis) along with the presence of moderateoedema/ infiltrates in the interstitium and the adjacent cortex (Fig. 5).Splenic artery appeared to be occluded with a bacterial embolic thrombus firmly attached to the lumen of the vessel consisting of concentric layers of fibrin, numerous inflammatory cells and RBC's and had clusters of basophilic bacterial colonies (Fig. 6).

Septic peritonitis observed in the present case was due to the presence of 3 perforations in the duodenal segment.Septic peritonitis has been observed to be a frequent complication associated with injuries that affect the gastrointestinal integrity (Ragetly*et al.*, 2011). Perforation of the stomach / intestine leading to leakage of the partially digested feed material as well as rupture of the infected uterus can result in acute secondary septic peritonitis. Agents frequently associated with secondary peritonitis are intestinal foreign bodies

(Penninck and Mitchell, 2003); perforations of the stomach, intestines, rectum, urinary bladder, or uterus; gastrotomy or enterotomy; gastric / intestinal neoplasms (eg, mesothelioma); inflammatory / traumatic injuries of liver, gall bladder, pancreas, dilatation / volvulus of gastrointestinal segments, etc.

The dog had persistent vomition, was anorectic and lethargic, prior to death. It had injected mucous membranes, sunken eyes with marked dehydration, abdominal distension and localised pain on cranial abdominal palpation. Animals with secondary peritonitis may also show clinical signs associated with the primary disease. The classical observation through radiography is the absence of abdominal details and there is a focal or generalized "ground-glass" appearance. The GI tract can be dilated with air and/or fluid. Free air inside the abdomen can be present when there is rupture of any luminal organ or at times may be due to gas-producing anaerobic organisms in the absence of organ rupture (Fossum*et al.*, 2009).

The chemical mediators of inflammation producedsuch as histamine, serotonin, proteases and endotoxinsas a result of the leaked contents result in enhanced capillary permeability and outpouring of plasma proteins, solutes and water into the peritoneal cavity. The resulting inflammation enhances fibrin deposition, particularly in and around the site of injury and peritoneum, as well as the loss of isotonic fluid into the peritoneal cavity with concurrent haemo-concentration (Culp*et al.*, 2009). The fluid produced is clear and transparent (transudate) during the early stages, but becomes turbid as a result of exuded protein, macrophages and polymorphonuclear leukocytes (Kirby., 2003, Culp *et al.*, 2009).In the present case, the abdominal cavity contained abundance of sero-sanguinous fluid and fibrin deposits. The resulting exudate further inhibits microbial clearance and enhances microbial multiplication (Kirby, 2003).

Infarction of different organs has been frequently reported during peritonitis as a result of ischemic injury caused by the vascular obstruction and thromboembolism. Owing to the greater circulating blood supply (20% to 25%), kidneys and spleen are the most frequent targets of thromboembolism. In the present case also, we observed renal and splenic infarcts. The small blood vessels are frequently occluded, i.e., the interlobular arteries and therefore, infarction occurs mostly in the cortical region (Zachary, 2012). In the present case, renal infarcts were seen in the cortex concurring with the previous reports.

Several agents including gastric mucin, bile salts, haemoglobin, etc., are regarded as adjuvants of the inflammation of peritoneum and they accentuate the localized as well as the systemic inflammation (Kirby, 2003). Opsonins, immunoglobulins and complement components get triggered with increasing severity of the inflammation (Schein and Paladugu2000, Culp *et al.*, 2009). In addition, the levels of several cytokines including TNF, IL-1 and IL-6, PGE_2 and platelet aggregation factor are also increased (Culp*et al.*, 2009). As a result of the production of these chemical mediators, there is a marked decrease in cardiac output, vasodilation and decreased venous return, which further intensify the systemic hypotension and enhance production of endotoxins. The presence of bacteria, the endotoxins, inflammatory cells and their cytokines lead to endothelial damage and tissue factor expression that result in generalized activation of the coagulation cascade, causing thrombosis and fibrinolysis. This results in disseminated intravascular coagulation with the loss of the anti-thrombin III protein into the abdomen. Micro and macro vascular thromboses may lead to tissue hypoxia and organ damage involving the myocardium, lungs, and gastrointestinal tract (DeLaforcade*et al.*, 2003;Estrin*et al.*, 2006).These pathological changes that occur during septic

peritonitis result in systemic vasodilation, enhanced capillary permeability, reduced cardiac function and multiple organ failure, the characteristic signs of systemic inflammatory response syndrome and septic shock (Schein and Paladugu, 2000). In spite of the advanced treatment strategies available, the prognosis of peritonitis is poor.

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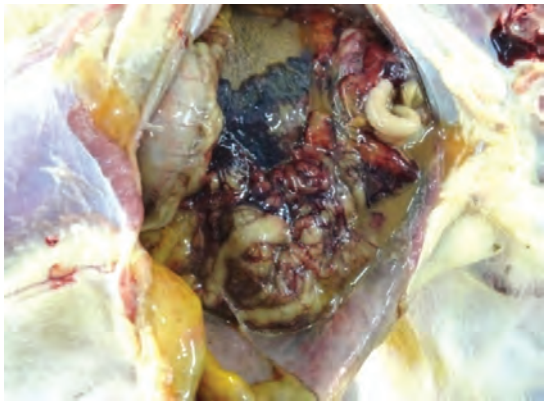

Figure 1: Gross changes in the abdominal cavity

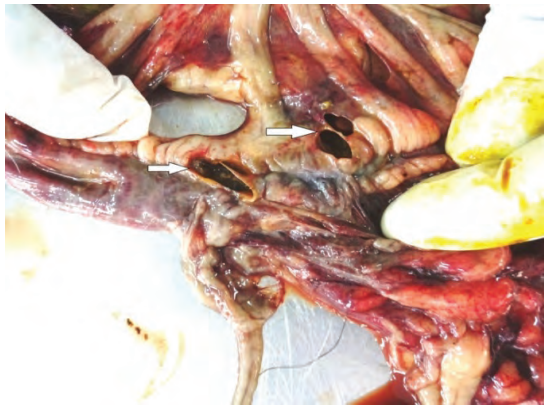

Figure 2: Intestine showingperforations

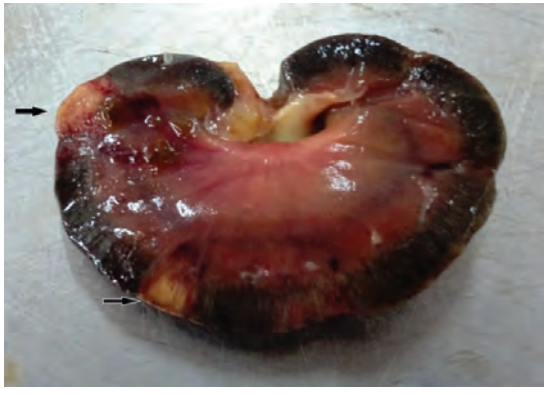

Figure 3: Cut surface of Kidney showing gross lesions

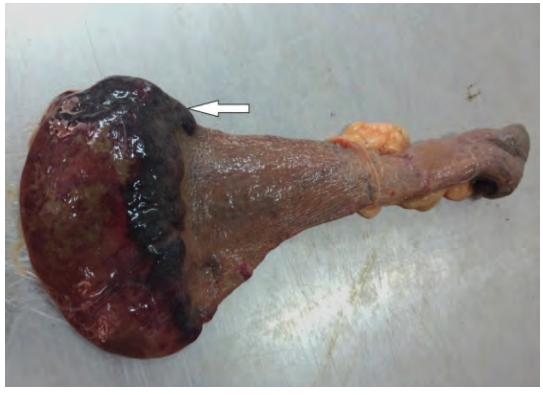

Figure 4. Spleen showing gross lesions

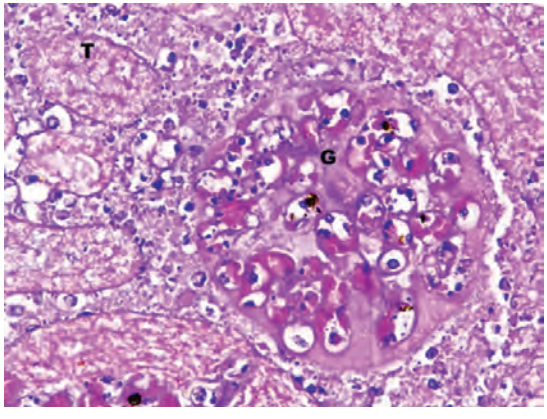

Figure 5: Kidney showing infarct and diffuse coagulative necrosis of the glomeruli (G)and the tubules (T), interstitial oedema / congestion H&E,100×.

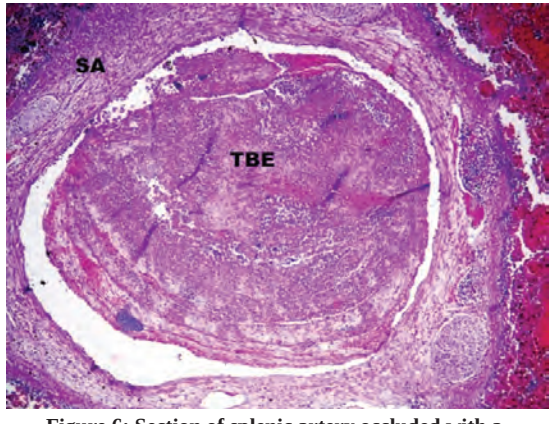

Figure 6: Section of splenic artery occluded with a bacterial embolic thrombus, H & E, 40 ×

Comparative advantage of livestock component in reduction of poverty – logistic regression approach*

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ABSTRACT

A logistic model was fitted for the sample respondents to explore the determinant factors of poverty and comparative advantage of livestock component in reduction of poverty was ascertained. The primary data were collected through personal interview from randomly selected 540 sample households from six poverty prone districts using pre-tested interview schedules. Among various variables presumed to be the determinants of poverty, the variables viz., Ariyalur district dummy, cattle holding, sheep holding, family size, family dependency ratio were found to be statistically significant and rest were non-significant. The number of cattle and sheep were found to reduce the probability of fell down below the poverty line. Thus, these components may be considered while framing any poverty alleviation programmes in rural India.

Key words: Poverty – Livestock– Determinants – Logistic regression

Indian economy is a clear example of dualism. India excels in food production on one side, however on the other hand nearly 363 million people live in extreme poverty in India and face deprivation in terms of nutrient intake and access to basic services. These facts revealed that despite the country's meteoric GDP growth rate, poverty in India is still pervasive, especially in rural areas. Hence, the study of poverty is an important issue in the field of development. No development can even be thought of if any household / person in any country lives below the poverty line (Chatterjee, 2009). In this context, the present study was undertaken to fit a logistic model to explore the determinant factors of poverty and comparative advantage of livestock component in reduction of poverty.

#Part of the Ph.D. thesis of the first author submitted to the Tamil Nadu Veterinary and Animal Sciences University, Chennai

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Six sample districts of Tamil Nadu *viz.*,Thiruvannamalai, Villupuram, Dharmapuri, Pudukottai, Ariyalur and Ramanathapuram located in southern part of India were selected based on the composite poverty indices. From each selected district, 90 respondents comprising different occupational groups were selected through multi-stage random sampling leading to the sample size of 540 sample households. The data pertaining to the objectives of the study were collected through personal interview using structured pre-tested interview schedule. The period of data collection was from August 2013 to October 2014.

A logistic model was fitted for the sample respondents to explore the determinant factors of poverty. In explaining a dichotomous dependent variable (Y_i), where '1' represents person falling below poverty line, and '0' represents above poverty line. The relationship between dependent and independent variables is non-linear, a logistic function was used to estimate the association between binary dependent variable Y_i and the independent variables (X_{ij}s). The following mathematical form of the model was used in the present study.

$$\ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \sum_{j=1}^{k} \beta_j X_{ij} + \mu$$

Where, p_i is the probabilityofith household to fall below poverty line and X_{ij} is the jth explanatory variable of ith household. The dependent variable $\ln\left(\frac{p_i}{1-p_i}\right)$ is the log-odds ratio in favour of sample households to fall below poverty line.

The results of the logit model to assess the determinant factors of poverty are given in Table 1. On perusal of table, it could be noted that the model Chi square was 411.018, which implied that the model was statistically significant. Among 25 variables presumed to be the determinants of poverty, the variables *viz.*,Ariyalur district dummy, cattle holding, sheep holding, family size, family dependency ratio were found to be statistically significant and rest were non-significant (P>0.05). Among the significant variables, the variables cattle holding and sheep holding alone were the negative determinant factors of poverty, which indicated the negative relationship between cattle and sheep holding with the existence of poverty.

The variables namely Ariyalur district dummy, family size and family dependency ratio were found to be positive determinant factors of poverty similar to the findings of Hashmi *et al.* (2008). As the family size especially number of dependents increases, the total family income has to be shared for more number of family members which lead to decrease in per capita income. Thus the individual household might have more chance to fall below the poverty line, if the family size and number of dependents increases. In contrast, as the cattle and sheep holding provides regular and more income for the livestock farmers, these variables had negative relationship on the determinants of poverty. The results are in line with the findings of Ambika (2003).

The reliability of the usage of the logit model for the correct prediction of below poverty line and above poverty line was tested by comparing the observed and predicted values. The percentage of correct prediction by the logit model was 87.40 per cent. The model was successful in predicting the above poverty line (88.10 per cent) correctly than the below poverty line (86.60 per cent).

Thus, it could be concluded that special attention must be given to Ariyalur district so as to uplift the people from clutches of poverty. As the number of cattle and sheep were found to reduce the probability of fell down below the poverty line, these components might be considered while framing any poverty alleviation programmes in rural India.

ACKNOWLEDGEMENT

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Nadu Veterinary and Animal Sciences University, Chennai. The authors thank Tamil Nadu Veterinary and Animal Sciences University, Chennai for giving permission and support for completion of research work.

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Table 1
Estimates of binary logistic model to explore determinants of poverty

X_i	Explanatory variables	Co-efficients	Standard error	t value	P value
X_1	Villupuram district	-0.185	0.484	0.146	0.703
X_2	Dharmapuri district	0.096	0.515	0.035	0.851
X_3	Pudukottai district	1.017	0.565	3.241	0.072
X_4	**Ariyalur district**	**1.207***	**0.571**	**4.462**	**0.035**
X_5	Ramanathapuram district	0.240	0.681	0.124	0.725
X_6	Cropping occupation	-0.140	0.505	0.077	0.781
X_7	Livestock farming occupation	-0.107	0.444	0.058	0.809
X_8	Fishing occupation	-0.164	1.053	0.024	0.877
X_9	AgriculturalLabourer occupation	19.873	5939.621	0.000	0.997
X_{10}	Non-farm occupation	0.193	0.804	0.058	0.810
X_{11}	**Number of cattle**	**-1.453****	**0.343**	**17.920**	**0.000**
X_{12}	Number of buffalo	0.220	0.682	0.104	0.748
X_{13}	**Number of sheep**	**-0.302***	**0.129**	**5.494**	**0.019**
X_{14}	Number of goat	-0.243	0.359	0.459	0.498
X_{15}	Age of the head of household	0.000	0.015	0.002	0.968
X_{16}	Gender of the head of household	0.249	0.404	0.379	0.538
X_{17}	Illiterate dummy	0.540	0.340	2.516	0.113
X_{18}	**Family size**	**0.237***	**0.100**	**5.640**	**0.018**
X_{19}	**Family dependency ratio**	**14.249****	**1.433**	**98.903**	**0.000**
X_{20}	Hindu Religion dummy	0.759	0.781	0.944	0.331
X_{21}	Christian Religion dummy	-0.072	1.000	0.005	0.943
X_{22}	Scheduled Castes (SC) dummy	0.523	0.420	1.551	0.213
X_{23}	Scheduled Tribes (ST) dummy	0.667	0.458	2.122	0.145
X_{24}	Landholdings	-0.032	0.048	0.435	0.510
X_{25}	Value of assets owned	0.000	0.000	2.021	0.155

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X_{25}	Value of assets owned	0.000	0.000	2.021	0.155
	Constant	**-9.895**	**1.530**	**41.843**	**0.000**
	Model Chi square	**411.018****			
	-2 Log likelihood	**333.658**			
	Nagelkerke R square	**0.712**			
	N	**540**			

*** Significant at one per cent level and * Significant at five per cent level*

Classification Table

Observed		Predicted		
		Below poverty line		Percentage correct
		Yes	No	
Below poverty line	Yes	214	33	86.6
	No	35	258	88.1
Overall percentage				**87.4**

Dystocia due to dizygotic twins in a crossbreed cow - a case report

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ABSTRACT

Twining incidenceis influenced by a wide variety of genetic and environmental factors ranging from 0.5 to 4%. This case report places on record the successful management of dystocia due to dizygotic twins in a pluriparous cross-breed cow of four and a half year of age in her third parity. Both fetuses were non identical and had separate placenta which suggest 'Dizygotic twins'.

Key words: dystocia, dizygotic twins, cow

In uniparous species, twining is a highly undesirable trait. The incidence of twinning in sheep and goat is very high (60-70%), whereas low in dairy cattle (1.04%) and mare (0.5-1.05%) (Roberts, 1971). Bovine twins are of the two types 1) monozygotic twins, genetically and phenotypically identical, since they are formed from one fertilized egg, which splits into two identical halves during early embryonic developmental stages and thereby both individuals are always of the same sex. 2) Dizygotic or fraternal twins are not identical genetically or phenotypically as monozygotic twins, since they are formed from two different sperms fertilizing with two completely different ova at the same time. Dizygotic twins are the most common typeand not necessarilyof the same sex because they are the result of ovulation and fertilization of two different oocytes. They can be also as similar or different as any two siblings born from the same parents during different gestations (Wakchaure and Ganguly, 2016).

A pluriparous cross-breed cow of four and a half year of age in her third parity was brought to Government Veterinary Hospital, Prahladpur, District Kurukshetra (Haryana) with a history of unproductive straining with all the four limbs of the calf partially visible near the vulval lips. The general condition of the animal was fair and the pelvic ligaments were totally relaxed. Rectal temperature, respiratory rate and pulse rate of the animal were within the normal range.

The birth passage was completely relaxed and sufficient fetal fluids were present. Per vaginal examination of all the four limbs revealed that they were all forelimbs. Fetal head was also deviated to right side and fetal reflexes were also present. Further exploration revealed another head deep inside the birth canal and it was diagnosed as a case of dystocia due to twin fetus.

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Fig.- Twin live female fetus

After determining the relation of appendages to each fetus, mutational operations like retropulsion of two limbs, correction of lateral deviation of head and neck and traction of one fetus followed by another was performed and two live female fetus were delivered. Both fetuses were non identical and had separate placenta which suggest 'Dizygotic twins'.Careful examination of the birth canal revealed no injury or laceration subsequent to mutational operation. Parenteral administration of antibiotics [Ceftrioxone+Tazobactum-4.5gm (Intaceftazo-Intas Pharmaceuticals)] and analgesics [Meloxicam 30 ml (Melonex-Intas Pharmaceuticals)] intramuscularly daily for three days to prevent secondary bacterial infection due to external contamination during manipulation was followed and the cattle recovered uneventfully.

Twining incidenceis influenced by a wide variety of genetic and environmental factors ranging from 0.5 to 4% (Fricke,2015). There is higher incidence of twins in dairy cattle as opposed to beef cattle (Rutledge, 1975). Increased nutritional intake to improve productivity also increases the twinning incidences. Economic loss due to twining in cows often results from higher incidence of abortions,subclinical or clinical ketosis, reduced birth weight or stillbirths, mastitis, and problems related to dystocia.

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All the contributing authors are requested to bestow their personal attention while submitting the revised manuscripts for spelling mistakes and correctness of language.

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