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BIRTH WEIGHT, LITTER SIZE, SEX RATIO AND NEONATAL MORTALITY IN PUREBRED MUDHOL HOUNDS

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Abstract: An experiment was designed to document the reproductive efficiency parameters in Mudhol Hound breed of dog and to determine if the reproductive efficiency parameters are influenced by system of feeding, namely feeding with a nutritionally balanced diet or homemade diet. Reproductive efficiency was measured in terms of birth weight of puppies, liter size and neonatal mortality. The overall mean birth weight of Mudhol Hound puppies was determined as 458 ± 0.18 g and ranged between 415 to 479 g which was similar to the birth weight reported for medium sized dogs. The male puppies in both the groups were weighed significantly higher (479.11 ± 3.44 g *vs.* 437.00 ± 5.47; 450.11± 3.44 *vs.* 415.00 ± 4.47) than new born female puppies. The pups from dogs maintained on homemade diet had significantly lower birth weight with significantly ($p<0.05$) higher prevalence of neonatal mortality (7.24% vs.15.79%) compared to scientific feeding system. The litter size was also smaller in dogs maintained on homemade diet (5.76 ± 0.31). Further, the overall ratio of male and female puppies born was determined as 1: 1.08 and was insignificant between the groups.

Keywords: Scientific feeding, Homemade feeding, Litter Size, Birth Weight, Neonatal Mortality, Mudhol hound.

Introduction

Currently the FCI has recognized 332 fully official breeds and 11 provisional breeds. Majority of these recognized breeds are belonging to western Countries. India has got a vast array of many species of domestic and companion animals. Dog has been theimportant companion animal since time immemorial. In India 20 dog breedswere identified but none of these are internationally recognized. The excellentdog breeds like Rajapalayam, Chippiparai, Kombai, Kanni, Mudhol Hound, Rampur Hound, Caravan Hound, Banjara Hound,

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Bhotia sheep dog, Himalayan sheep dog, Alangu, Kaikadi, Indian Spitz,Bakharwal and Jonangi. The state of Karnataka in southern India is blessed with three such indigenous dog breeds, of which, Mudhol Hound is one among them. It is rare desi dog found in and around Bagalkot and Vijayapur districts of Northern part of Karnataka. Even the Kanni, another Indian dog breed found in Tamil Nadu, was considered as a further extension of the Caravan or Mudhol Hound and was also a descendant of the Saluki (Ravimurugan and Kumaravelu, 2008; Srinivasan, 2011).

In the recent, though the efforts are going on assessment of desi canine breeds both at phenotypic as well as molecular level, again those studies are limiting majorly to Rajapalayam, Kanni and Chippiparai dog breeds in Tamilnadu. But as such no such systematic efforts have been carried out to establish reproductive parameters, reproductive efficiency parameters in Mudhol Hound breed of dogs.

As a part of standardizing, improve and optimize breeding, increased knowledge about reproductive parameters is essential. Hence, this cross-sectional study was conducted to record the mean litter size, sex ratio, Body weight of new born and Neonatal mortality in purebred female Mudhol Hound dogs.

Materials and Methods

For the present study 30 Mudhol Hound dogs each maintained under scientific feeding management at CRIC, Timmapur and those maintained with homemade diet by pet owners in and around Mudhol were used to study the influence of the type of diet fed to dog on the reproductive efficiency. It was assessed in terms of birth weight of puppies, litter size and sex ration, incidence of neonatal mortality in female Mudhol Hound dogs. Further, these reproductive efficiency parameters are compared between the two systems of feeding management *viz.,* feeding of balanced commercial food and feeding of homemade food.

a. Birth weight of new born: It was recorded to nearest gram using body weighing scale.

b. Litter size and sex ratio: Litter size was defined as the sum of live born and dead born puppies. Following whelping process, the litter size and sex ratio among new born puppies was recorded. The litter size value was described by use of arithmetical mean, standard error and range

c. Incidence of neonatal mortality: Neonatal mortality was defined as any puppy mortality occurring from birth to weaning (40 days) and the incidence of neonatal mortality was determined using following formula.

Incidence of Neonatal mortality

$$= \frac{\text{Number of puppies exhibiting mortality upto 40 days}}{\text{Total number of puppies born}} \times 100$$

The data for Mudhol Hound dogs maintained under scientific feeding management were taken from records kept with CRIC, Timmapur and same for Mudhol dogs with pet owners were collected by providing data entry formats. Statistical analysis was carried out as per method described by Snedecor and Cochran (1989).

Results and Discussion

1. Weight of puppies at birth

The mean birth weight (Table-1) of male and female puppies born to the Mudhol dogs maintained under scientific system of feeding and management was found to be significantly ($P<0.05$) higher compared to those maintained with homemade diet. To date, despite the growing interest in breeding and selecting purebred dogs, no studies are available on the effect of birth weight affecting litter size and neonatal mortality. Birth weight is considered as an important survival determinant in most mammalian species (Gatel, *et al.,* 2011). Low birth weight is accompanied by immature development and adaptive postnatal failure that can predispose to neonatal mortality (Tonnessen *et al.*, 2012). We speculated that low birth weight should be considered as prognostic of survival within 24 h from birth, but not as discriminating between live born and stillborn pups. Intrauterine growth retardation, a condition affecting polytocous species, including dogs, is characterizedby low weighing and distressed pups compared to litter-mates (Wootton, *et. al.,* 1983). Assistance attempts should be focused on these underweight live born pups in order to reduce the percentage of perinatal mortality

Besides, the size of the breed, the birth weight of new born is also reported to be influenced by variety of factors such as genetics, environment, nutrition and fetal uterine position (Bautista *et. al.,* 2015). The definite role of genetics influencing the birth weight was reported in case of boxer puppies (Nielen *et. al.,* 2001). Further, birth weight was related to maternal size, weight and age as well as breed and litter size with heavier puppies in small rather than larger litter from medium sized breeds (Gropetti *et. al*., 2015).

The present study, also found that the Mudhol Hound male puppies weighed significantly heavier than the female puppies, irrespective of the system of feeding on which the dam was being raised (Table-1, Figure-17). On an average, the male were about 35 to 40 g heavier than female puppies. Similarly, in Romanian Bucovina shepherd dog (Pascal and Gaspar

2015) the male puppies weighed about 52 g more than new born female puppies and in case of boxer puppies also the males weighed slightly heavier but significantly higher compared to female puppies(Biglardi*et.al.,* 2013). The heavier size of male offspring as compared to female offspring has also been described (Gianola and Tyler, 1974; Johnson and Berger, 2003)in cattle. The heavier birth weight of male offspring is probably due to a heavier muscular and skeleton mass which could be influenced by male hormone.

The present study also revealed that the nutritional status of mother had a significant influence on body weight of new born, with pups of dams maintained on nutritionally balanced diet weighing of about 35-40 g more than the pups from dam maintained on homemade diet.The effect of plain of nutrition on body weight of new born in bitch appears to have received little attention. However, in woman, fetal growth retardation has been documented due to insufficient concentration of nutrition in the mothers' blood stream (Howie, 1982). In the pigs, the birth weight of piglets has been related to the size of placenta with heavier piglet associated with a heavier placenta, to date, the relationship between size and weight of placenta with birth weight of neonates has not been studied in bitches and it is possible that the better plane of nutrition may be associated with a heavier placenta and therefore higher body weight in dogs recorded in the study.

2. Litter size and Sex ratio

The litter size and sex ratio obtained in different regimes of feeding and management are presented in Table: 2.The mean litter size under scientific feeding management was significantly ($P<0.05$) higher compared to the home-made feeding system. The range for litter size was narrower (4-10) in scientific feeding management compared to the homemade diet (1-11).

Further, whelpings in each group are subdivided into different groups (Table. 3) based on age of the dam consisting of <2 years, 2-4 years and >4 years, which revealed that the litter size was non-significantly ($p>0.05$) higher in scientific feeding compared to homemade feeding counterparts. The mean litter size did not differ significantly irrespective of system of feeding and age of the dam. Moreover, increase in age of dam leading to increase in the size of the litter, suggesting positive correlation between litter size and age of the dam. This is consistent with the findings in previous studies (Robinson., 1973, Thomassen e*t. al.*, 2006 and Gill., 2001). A large dog can give birth to a greater number of puppies while the relative size of the foetus compared to the bitch is larger in bitches of smaller breeds than in bitches of larger breeds. But at some point, the linear correlation between litter size and breed size must level

out due to biological factors, such as limited space in the uterus and a limited number of teats. The grouping of breeds is based on body weight only, and breeds with different body conformation can sometimes end up in the same body weight class. Previous studies on larger dog breeds report a mean litter size of 6.90 (Eilts e*t. al.*, 2005) and 7.6 (Indrebo *et .al.,* 2007), which is similar to the results found for the large and giant dog breed groups.

Reported factors influencing litter size are for example season of the year, number of previous litters (Gavrilovic *et. al.,* 2008), age of parents (Borge *et. al.,* 2011), and breed (Okkens *et. al.,* 2001; Borge *et. al.,* 2011). However, results published in various studies are inconsistent (Gavrilovic *et. al.,* 2008; Borge *et. al.,* 2011), possibly because they are based on reproductive efficiency data sets of bitches pertaining to various breeds (Bouchard *et. al.,* 1991; Okkens *et. al.,* 2001; Eilts *et. al.,* 2005; Chatdarong *et. al.,* 2007; Ortega-Pacheeo *et. al.,* 2007; Borge *et. al.,* 2011) and very few studies deal with reproductive efficiency of only one dog breed, more specifically Drever (Gavrilovic *et. al.,* 2008), Irish Hounds (Urfer 2009), German Shepherds (Mutembei *et. al.,* 2002), Beagles (Shimatsu *et. al.,* 2007), Boxers (Forsberg and Persson 2007), and English bulldog breed (Wydooghe *et. al.,* 2013). Moreover, results of some studies are only based on data from a questionnaire (Mutembei *et. al.,* 2002; Forsberg and Persson 2007; Wydooghe *et. al.,* 2013) and there is no information (or no rigorous information) about reproductive management of the breeders concerned. Other possible factors influencing the reproductive pattern of bitches are said to be different housing, nutritional conditions, and probably management (e.g. proper timing) of mating or insemination (Gavrilovic *et. al.,* 2008), i.e. specific environmental influence (Mutembei *et. al.,* 2002). Borge *et. al.,* (2011) mention that even though mean litter size is breed-specific, information on the expected number of puppies born for a particular breed is lacking and this knowledge is useful both for breeders and veterinarians. The mean litter size of Mudhol Hound female dog which is medium sized dog, therefore appeared to be similar to litter size of other medium sized breed of dogs.

The present study also confirmed the importance of feeding dogs with nutritionally balanced food for optimizing the litter size. Although several studies have stated that dogs maintained on poor diet have a lower birth weight, there is little mention on litter size.

In the present study, expectedly sex ratio (Table. 2) did not vary significantly between the two systems of feeding. This sex ratio issimilar to the ratio of male and female puppies born to Dogo Argentina Bitch (Caffaratti *et. al.,* 2013). Similar ratio also has been reported in the Draver breed of dog (Gavrilovic *et. al.,* 2008). The result of present study suggest that the sex

ratio of Mudhol Hound breed of dog is similar to those seen in other breeds of dogs and is not influenced by system of feeding.

3. Incidence of neonatal mortality in Mudhol dogs

The overall incidence of neonatal mortality defined as the death of puppies occurring from time of delivery to the time of weaning was determined as 10.67% (Table- 4). In other reports, the incidence of canine neonatal mortality was reported to range 17 -30% within first 8 weeks of age (Nielen *et. al.,* 1998, Vander Beek *et. al.,* 1999 and Hopper *et. al.,* 2004) and the death within first week of post partum wasresponsible for majority of puppy losses in these studies. In comparison to other species, prevalence of canine neonatal mortality is considerably higher and is related to many factors including prolonged labor, maternal neglect or carelessness, lack of milk, congenital abnormalities and acquired disorders of neonates (Nielen *et. al.,* 1998 and Hopper *et. al.,* 2004).

Fading puppy syndrome, considered to be an important factor for neonatal mortality, etiology for the same includes a whole range of causes, like poor mothering, inadequate nutrition, inadequate colostrum, trauma and congenital anomalies, low birth weight and infections [Blunden, 1998; Sturgess, 2006]. The clinical signs of many neonatal diseases are very similar and vague, like restlessness, crying, low body temperature, diarrhoea and breathing difficulties, in absence of a more specific diagnosis, the term fading puppy syndrome is often used. Because of the immature status of the newborn puppy, a sick neonate may rapidly become hypothermic, hypoglycemic, dehydrated and hypoxic resulting in die – regardless of the initiating insult (Gunn Moore, 2006).

Dystocia is among the principal causes of neonatal mortality in dogs, mainly due to uterine inertia and fetal malpresentation (Tonnessen, *et. al.,* 2012). Although elective C-section is recommended in singleton pregnancies as the size of the pups may predispose to dystocia (Smith, 2007), in our sample birth weight did not differ between dystotic and eutotic pups. It should be noted that neonatal mortality in German Shepherd dog was higher in smaller litters than in larger ones ($P < 0.05$, Mutembei *et. al.,* 2002). Moreover, the birth weight in German Shepherd dog was remarkably high in relation to the breed size and weight. We can assume that breed-specific characteristic such as mesocephalic and mesomorphous conformation makes German Shepherd dog able to whelp oversized pups by eutocic parturition but resulting in distressed pups and higher neonatal mortality as in the case of small litters.

In the present study, the incidence of neonatal mortality was comparatively lower than those reported in other studies. Further, the incidence of neonatal mortality was significantly lower

in dogs maintained on a balanced nutrition. The observations show the influence of maintaining the dogs on nutritionally balanced diet to improve the survivability of neonates. The beneficial effects of nutrition could be a better birth weight of new born as observed earlier. It is also possible that dogs maintained on nutritionally balanced diet have a better milk yield and significantly higher immunoglogubulin concentration in the milk which could contribute to the better immunity of neonates.

Conclusion

The present study indicate the positive influence of better feeding management on birth weight and litter size. Further, the litter size is also positively correlated with age of the dam irrespective of the feeding system. The neonatal mortality is also less in case of scientific feeding management helping in better survivability of the puppies in their critical period of life compared to homemade diet. Hence, it is concluded that when Mudhol Hounds maintained for breeding purpose, feeding of nutritionally balanced diet would increase puppy birth weight, litter size and reduce the prevalence of neonatal mortality.

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Table-1: Birth weight (gms) of male and female puppies born to Mudhol Hound female dogs maintained on nutritionally balanced diet and on homemade diet

Sl. No	System of feeding	Mean Birth weight of puppies (g)	
		Male	Female
1	Feeding of nutritionally balanced food	479.11 ± 3. 44[a] (n =75)	437.00 ± 5. 47[b] (n =83)
2	Feeding of homemade diet	450.11 ± 3.44[b] (n=53)	415.00 ± 4. 47[d] (n=61)
	Overall (n= 272)	458.00 ± 0.18 gm (Range: 415- 479)	

*Mean birth weight with different superscript are significantly different ($p<0.05$)

Table-2: Litter size and Sex ratio in Mudhol Hound female dogs maintained on nutritionally balanced diet and on homemade diet

Sl. No	System of feeding	Litter size (in Nos)		Sex ratio (Male:Female)
		Mean ± SE	Range	
1	Nutritionally Balanced food (n=19)	7.72 ± 0.28[a]	4-10	1:1.02[a]
2	Homemade diet (n=15)	5.76± 0.31[b]	1-11	1: 1.14[a]
	Overall (n=34)	6.74 ± 0.23	1-11	1: 1.08

*Mean value of litter size in Mudhol dogs maintained on nutritionally balanced diet and on homemade diet are significantly different ($p<0.05$)

Table 3: Influence of age of dam on litter size of Mudhol Hound female dogs maintained on nutritionally balanced diet and on homemade diet

Sl. No	Systems of feeding	Litter size in Different age groups		
		Less than 2 years of age	2 to 4 years of age	More than 4 years of age
1	Nutritionally Balanced food	7.23 ± 0.32a	7.89 ± 0.28[a]	7.70 ± 0.43[a]
2	Homemade diet	5.22 ± 0.42a	5.98 ± 0.36[a]	5.67 ± 0.28[a]
	Overall	5.63 ± 0.34	6.94 ± 0.32	6.69 ± 0.38

*****Values with similar superscript along the column are not significantly different ($p>0.05$)

Table-4: Prevalence of neonatal mortality of puppies born in Mudhol Hound female dogs maintained on nutritionally balanced diet and on homemade diet

Sl. No	System of Feeding	Total no of puppies born	Number of puppies which died before weaning	Percentage of Neonatal mortality
1	Nutritionally Balanced food	158	11	7.24 [a]
2	Homemade diet	114	18	15.79[b]
	Overall	272	29	10.67

*values with similar super script are not significantly different