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Research Article

EFFECT OF TRANSFERRIN POLYMOROPHISM ON REPRODUCTIVE TRAITS OF BLACK BENGAL GOAT

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ABSTRACT: The present investigation was carried out to find out the relationship of biochemically polymorphic blood protein transferrin with important reproductive traits in adult Black Bengal goats. Least square analysis of data depicted non-significant relationship of transferrin types with most of the reproductive traits except age at puberty and age at first kidding where transferrin phenovariants had significant effect ($p<0.01$, $p<0.05$). The TfBC phenovariant was significantly related with lower age at puberty (5.987 ± 0.205 months), lower estrous interval (20.233 ± 0.410 days) and lower age at first kidding (11.966 ± 0.190 months) while TfCC phenovariant performed better for post-partum heat period (40.267 ± 2.220 days) and average kidding size (2.841 ± 0.203). Black and white coat colour performed better for these reproductive traits in Black Bengal does. The average estimates were 6.344 ± 0.258 months for age at puberty, 20.522 ± 0.551 days for estrous interval, 11.977 ± 0.229 months for age at first kidding, 40.375 ± 1.783 days for post-partum heat period and 2.338 ± 0.134 for average kidding size. Analysis of interaction effect of phenovariant and coat colour revealed that black and white mixed coat colour goat having TfBC phenovariant was superior for age at puberty (5.000 ± 0.010 months), estrous interval (18.500 ± 1.500 days) and age at first kidding (11.250 ± 0.250 months) while TfAC phenovariant with mixed black and white coat colour animal showed minimum days of post-partum heat period of 35.000 ± 2.886 days. White coat colour animal with TfCC phenovariant was better performer for maximum average kidding size (3.250 ± 2.000).

Key words: Black Bengal Goat, Transferrin Polymorphism, Reproductive trait.

INTRODUCTION

The Black Bengal goat well recognized for its meat and quality skin in the world is widely distributed in the eastern region of India and also in part of Bangladesh. The most predominant coat colour is black although brown, white and admixtures of black and white colours are also frequent among the population of this goat breed. Genetic improvement of a population is possible by creation of superior genotype adopting the selection procedure with the help of biochemically polymorphic proteins (Erkoc *et al*. 1987). Transferrin is such an iron binding blood protein takes part in absorption and transportation of iron to bone marrow and other storage organs thereby helps to combat with the external environment and thus in adaptation. Genetically controlled polymorphism was studied in different farm animals serves an excellent tool for characterization of several protein components. Among them, Transferrin polymorphs may act as suitable biochemical marker for early selection of Black Bengal goat in cost effective breed improvement program. Therefore, the present investigation was carried out with an aim to find out the relationship of biochemically polymorphic blood protein transferrin with important reproductive traits in Black Bengal goat using least square technique.

MATERIALS AND METHODS

General appraisal

A total of 199 apparently healthy adult Black Bengal does (above 12 months) available in four districts *viz*., Birbhum, Hooghly, North 24 Parganas and Nadia of West Bengal, India were selected randomly from the village of each district under study. The animals were reared in traditional semi-intensive system with a day grazing in nearby fields and night shelter at the farmer's house. The traditional breeding system with natural service was followed for all the animals under study.

Six transferrin phenovariants viz. TfAA, TfAB, TfAC, TfBB, TfBC and TfCC as identified by Paul *et al.* (2017) were eventually considered to find out the effect on different reproductive traits of Black Bengal goat. The data on different reproductive traits viz. age at puberty

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(month), estrous interval (day), age at first kidding (month), post-partum heat period (day) and average kidding size (number) for Black Bengal does were collected through personal interview of the farmer at different villages of the entire study area.

Statistical analysis

Statistical analysis was carried out using the SPSS software program to estimate the effect of transferrin phenovariant, coat colour of does and interaction of phenovariant with colour varieties on different reproductive traits of Black Bengal does using Least Square Technique (Harvey 1966). The mean and standard error of the different reproductive traits under the study were calculated and test of significance was done by following standard methods as described by Snedecor and Cochran (1967). The relevant data were analyzed with the following statistical model:

$$Y_{ijk} = \mu + T_i + C_j + (TC)_{ij} + e_{ijk}$$

Where Y_{ijk} = Data pertaining to k^{th} individual in the i^{th} transferrin type and j^{th} coat colour.
μ = Overall mean
T_i = Effect of i^{th} transferrin types (i=1 to 6)
C_j = Effect of j^{th} colour (j=1 to 4)
$(TC)_{ij}$ = Effect of interaction of i^{th} transferrin type and j^{th} coat colour.
E_{ijk} = Random error associated with all observations i.e., NID ($\sigma^2 e$, 0)

RESULTS AND DISCUSSIONS

The effect of transferrin phenovariant, coat colour of animal and their interaction on different reproductive traits of Black Bengal does as studied in this investigation is presented as below.

Age at puberty (month)

In this present investigation, statistical analysis of data revealed that the overall mean of age at puberty for adult Black Bengal does was found to be 6.892 ± 0.122 months (Table 1). It was also observed that the average age at puberty was found to be maximum in TfAA (7.745 ± 0.447 months) phenovariant followed by TfAC (7.603 ± 0.281 months), TfAB (6.853 ± 0.144 months), TfBB (6.645 ± 0.227months), TfCC (6.517 ± 0.329 months) and TfBC (5.987 ± 0.205 months) phenovariant. Statistical analysis revealed that transferrin phenovariants had highly significant effect ($p<0.01$) on age at puberty of Black Bengal does under study. Black Bengal does belongs to the phenovariant TfBC type attained sexual maturity at an earlier age while TfAA individuals attained the same comparatively at higher/later age with a significant difference of nearly one and half month.

The average age at puberty of different colour varieties of Black Bengal does was also estimated in the present investigation and the respective means were found to be 7.325 ± 0.468 months for white variety, 7.040 ± 0.201 months for brown variety, 6.858 ± 0.118 months for black and 6.344 ± 0.258 months for black and white variety. It was observed in this study that the does with black and white coat colour attained earlier sexual maturity among the different colour varieties of Black Bengal does. Statistical analysis failed to show any significant effect of coat colour variety on this reproductive trait of Black Bengal does.

It was also observed that the mean age at puberty was found maximum in the group having white colour and TfAA phenovariant (9.285 ± 2.532 months) and lowest in black and white colour and TfBC phenovariant (5.00± 0.01 months) in Black Bengal does indicating the superiority of later one for this trait. Although a considerable variation for age at puberty existed in the population belonging to different colour varieties under study but the statistical analysis failed to show any significant effect of phenovariant and colour interaction on this reproductive trait.

Age at puberty ranged from 6.533±0.306 for TfBC to 7.571±0.480 for TfCC phenovariant among the black colour variety. It was varied from 5.00 ± 0.01 for TfBC to 7.666 ± 0.666 for TfAC phenovariant among the black and white colour variety while in brown colour variety it was 6.000 ± 0.010 for TfCC to 8.6 ± 0.4 for TfAC phenovariant. The estimated values for age at puberty were 6.250 ± 0.478 for TfBC to 9.285 ± 2.532 for TfAA phenovariant among the white colour variety of Black Bengal does. From the result it was clear that the animals having TfBC phenovariant and also the individuals with black and white coat colour independently attained puberty at a lower age which was almost in similar trend when interaction of both were taken into consideration.

The research finding of age at puberty was found to be 6.892 ± 0.122 month which was in accordance with the earlier findings of Miah *et al.* (2016), Das *et al.* (2008) and Zeshmarani *et al.* (2007) in Black Bengal goat. However, the result was in contrary with the research findings of Faruque (1999), Huq *et al.* (1988), Ghosh (1984) which slightly differs than the present study. The higher values for age at sexual maturity were reported in Ganjam and Black Bengal goats (Rao *et al.* 2002, Rao *et al.* 2009). Lower values for the same trait were reported in Black Bengal goats (Myenuddin and Wahab, 1989). The significant lower value of age at puberty in TfBC phenovariants of Black Bengal does was in agreement with the earlier findings of Khanra (1988). It was also observed from the result that the Black Bengal does having mixture of black and white coat colour alone along

Table 1. Least square means with standard errors showing the effect of Transferrin phenovariants, colour and their interaction on reproductive traits in Black Bengal goat.

	Age at Puberty (Month)	Estrous Interval (Day)	Age at First Kidding (Month)	Post Partum Heat Period(Day)	Average Kidding Size (No.)
Overall (199)	6.892 ± 0.122	21.059 ± 0.148	12.542 ± 0.089	42.554 ± 0.658	2.290 ± 0.047
Phenovariant					
TfAA (42)	7.745 ± 0.447	21.050 ± 0.353	12.756 ± 0.194	40.562 ± 1.259	2.161 ± 0.103
TfAB (69)	6.853 ± 0.144	21.409 ± 0.235	12.573 ± 0.150	42.159 ± 0.977	2.222 ± 0.081
TfAC (27)	7.603 ± 0.281	21.842 ± 0.378	13.407 ± 0.314	44.213 ± 2.136	2.189 ± 0.124
TfBB (21)	6.645 ± 0.227	20.927 ± 0.604	12.265 ± 0.243	43.604 ± 2.833	2.139 ± 0.127
TfBC (27)	5.987 ± 0.205	20.233 ± 0.410	11.966 ± 0.190	44.520 ± 1.766	2.189 ± 0.127
TfCC (13)	6.517 ± 0.329	20.892 ± 0.302	12.285 ± 0.349	40.267 ± 2.220	2.841 ± 0.203
Significant	p<0.01		p<0.05		
Coat Colour					
Black (BL 103)	6.858 ± 0.118	21.073 ± 0.181	12.548 ± 0.114	41.707 ± 0.752	2.235 ± 0.067
Black-White (BW 18)	6.344 ± 0.258	20.522 ± 0.551	11.977 ± 0.229	40.375 ± 1.783	2.338 ± 0.134
Brown (BR 38)	7.040 ± 0.201	21.023 ± 0.421	12.744 ± 0.217	45.710 ± 1.906	2.126 ± 0.113
White (W 40)	7.325 ± 0.468	21.618 ± 0.335	12.899 ± 0.231	42.426 ± 1.734	2.461 ± 0.091
Phenovariant X Coat Colour					
Black Colour					
BLAA (23)	6.695 ± 0.212	21.434 ± 0.420	12.434 ± 0.233	40.000 ± 1.571	2.329 ± 0.135
BLAB (33)	6.575 ± 0.213	21.181 ± 0.309	12.393 ± 0.189	40.151 ± 0.118	2.262 ± 0.118
BLAC (17)	6.647 ± 0.328	21.235 ± 0.433	12.264 ± 0.315	42.352 ± 1.940	2.191 ± 0.170
BLBB (8)	7.125 ± 0.398	20.750 ± 0.700	12.687 ± 1.411	40.500 ± 1.127	2.166 ± 0.274
BLBC (15)	6.533 ± 0.306	21.266 ± 0.547	12.366 ± 0.278	42.666 ± 1.943	2.175 ± 0.189
BLCC (7)	7.571 ± 0.480	20.571 ± 0.480	13.142 ± 0.594	43.571 ± 3.400	2.285 ± 0.269
Black -White Colour					
BWAA (4)	7.000 ± 0.408	20.500 ± 1.848	12.250 ± 0.250	41.250 ± 2.393	2.400 ± 0.355
BWAB (5)	6.400 ± 0.509	21.800 ± 0.734	12.200 ± 0.663	41.000 ± 4.847	2.050 ± 0.122
BWAC (3)	7.666 ± 0.666	21.333 ± 1.763	12.666 ± 0.666	35.000 ± 2.886	2.666 ± 0.333
BWBB (2)	6.000 ± 0.030	20.500 ± 0.500	11.500 ± 0.500	37.500 ± 4.500	2.000 ± 0.060
BWBC (2)	5.000 ± 0.010	18.500 ± 1.500	11.250 ± 0.250	47.500 ± 2.500	2.000 ± 0.500
BWCC (2)	6.000 ± 0.010	20.500 ± 0.500	12.000 ± 0.040	40.000 ± 0.500	2.915 ± 0.585
Brown Colour					
BRAA (8)	8.000 ± 0.422	20.125 ± 0.914	13.625 ± 0.532	36.000 ± 3.422	1.718 ± 0.247
BRAB (14)	7.142 ± 0.274	21.714 ± 0.568	12.642 ± 0.324	44.428 ± 2.599	2.047 ± 0.197
BRAC (5)	8.600 ± 0.400	22.800 ± 0.969	14.200 ± 0.583	57.000 ± 2.830	1.800 ± 0.200
BRBB (3)	6.333 ± 0.333	20.333 ± 3.382	12.000 ± 0.020	52.666 ± 3.333	1.890 ± 0.110
BRBC (6)	6.166 ± 0.307	20.666 ± 0.918	12.000 ± 0.258	44.166 ± 3.515	2.388 ± 0.291
BRCC (2)	6.000 ± 0.010	20.500 ± 0.500	12.000 ± 0.010	40.000 ± 2.500	2.915 ± 0.585
White Colour					
WHAA (7)	9.285 ± 2.532	22.142 ± 0.670	12.714 ± 0.521	45.000 ± 3.273	2.197 ± 0.209
WHAB (17)	7.294 ± 0.294	20.941 ± 0.552	13.058 ± 0.358	42.058 ± 2.330	2.527 ± 0.155
WHAC (2)	6.962 ± 0.170	21.598 ± 0.370	15.235 ± 0.231	40.915 ± 0.102	1.839 ± 0.818
WHBB (8)	7.125 ± 0.398	22.125 ± 0.895	12.875 ± 0.440	43.750 ± 4.977	2.500 ± 0.163
WHBC (4)	6.250 ± 0.478	20.500 ± 0.957	12.250 ± 0.629	43.750 ± 6.984	2.192 ± 3.218
WHCC (2)	6.500 ± 0.500	22.000 ± 0.070	12.000 ± 0.010	37.500 ± 7.500	3.250 ± 2.000

with its interaction with TfBC phenovariant performed better for age at puberty indicated that this type of phenovariant may be used as a marker for selection to be effective in Black Bengal goat improvement program.

Estrous interval (day)

The overall mean estrous interval of Black Bengal does was estimated to be 21.059 ± 0.148 days in the present study (Table 1). Statistical analysis revealed that the average values of estrous interval for phenovariants TfAC, TfAB, TfAA, TfBB, TfCC and TfBC were observed to be 21.842 ± 0.378 days, 21.409 ± 0.235 days, 21.050 ± 0.353 days, 20.927 ± 0.604 days, 20.892 ± 0.302 and 20.233 ± 0.410 days, respectively.

Among the colour varieties, the mean estrous interval was found to be maximum in white colour variety (21.618 ± 0.335 days) followed by black (21.073 ± 0.181 days), brown (21.023 ± 0.421 days) and black and white (20.522 ± 0.551 days) in Black Bengal does.

The estrous interval was maximum due to combined effect of brown colour and TfAC phenovariant (22.8 ± 0.969 days) and minimum for does with the combination of black and white colour and TfBC phenovariant (18.5 ± 1.5 days).

Among the black colour variety the average days of estrous interval ranged from 20.571 ± 0.480 for TfCC to 21.434 ± 0.420 for TfAA phenovariant. Similar ranges were also observed for 18.5 ± 1.5 for TfBC to 21.8 ± 0.734 for TfAB phenovariant among the black and white colour variety while in brown colour variety it was 20.125 ± 0.914 for TfAA to 22.8 ± 0.969 for TfAC phenovariant. The estimated values for estrous interval in Black Bengal does were 20.5 ± 0.957 for TfBC to 22.142 ± 0.670 for TfAA phenovariant among the white colour variety.

Statistical analysis revealed that the effect of phenovariants, colour varieties and interaction of both had no significant effect on estrous interval in Black Bengal does. However, from the result it was found that the animals having TfBC phenovariant and also the individuals with black and white coat colour independently lower days of estrous interval trending similar when interaction of both were taken into consideration.

The overall estimate of estrous interval was found to be 21.059 ± 0.148 days which corroborates with the findings of Ali *et al.* (1973) who also reported estrous interval in Black Bengal goats to be 20.0 ± 1.68 days. From the result it is very apparent that the Black and white coat colour variety having TfBC phenovariants attained estrous in shortest duration of days compared to others. This relationship of coat colour, phenovariant types and their interactions with estrous interval could not be made possible due to non availability of earlier research findings in this regard.

Age at first kidding (month)

The present investigation revealed that the overall mean age at first kidding for Black Bengal does was found to be 12.542 ± 0.089 months (Table 1). The estimated average age at first kidding of Black Bengal does were found to be 13.407 ± 0.314 months for TfAC phenovariant, 12.756 ± 0.194 months for TfAA phenovariant, 12.573 ± 0.150 months for TfAB phenovariant, 12.285 ± 0.349 months for TfCC phenovariant, 12.265 ± 0.243 months for TfBB phenovariant and 11.966 ± 0.190 months for TfBC phenovariant. Statistical analysis showed that the age at first kidding differed significantly ($p<0.05$) among does having different transferrin phenovariants. Therefore, age at first kidding was highest for TfAC phenovariant which differs from TfBC phenovariant having the lowest value indicating its preeminence for early kidding.

Statistical analysis of age at first kidding according to the coat colour of Black Bengal does revealed that the mean age at first kidding was found to be maximum in white colour variety (12.899 ± 0.231 months) followed by brown (12.744 ± 0.217 months), black (12.548 ± 0.114 months) and black and white (11.977 ± 0.229 months), respectively (Table 1). However, analysis of variance failed to show any significant effect of colour varieties on age at first kidding trait. Overall analyzed result revealed that black and white coat colour variety does attained earlier age at first kidding among the different colour varieties of this goat breed.

Age at first kidding data of Black Bengal does was also subjected to analysis to show the effect of interaction of phenovariants and coat colour varieties on this trait. From the result it was obvious that the age at first kidding was found to be maximum in white colour with TfAC phenovariant (15.235 ± 0.231 months) and lowest value has been shown by black and white colour with TfBC phenovariant (11.250 ± 0.250 months) in adult Black Bengal does indicating black and white coat colour does having TfBC phenovariant was more superior for early kidding among the varieties of Black Bengal does.

Age at first kidding ranged from 12.264 ± 0.315 months for TfAC to 13.142 ± 0.594 months for TfCC phenovariant among the black colour variety. It was varied from 11.250 ± 0.250 months for TfBC to 12.666 ± 0.666 months for TfAC phenovariant among the black and white colour variety. It was varied from 12.0 ± 0.01 months for TfCC to 14.200 ± 0.583 months for TfAC phenovariant among the brown colour variety. It was varied from 12.0 ± 0.01 months for TfCC to 15.235 ± 0.231 months for

TfAC phenovariant among the white colour variety.

Interaction of coat colour and transferrin phenovariants had no significant effect on age at first kidding of Black Bengal does under study. It was observed that the animals having TfBC phenovariant and black and white coat colour independently showed lower age at first kidding had similar pattern when interaction of both were taken into consideration.

The present finding of age at first kidding of Black Bengal does (12.542 ± 0.089 months) was comparable with the published research findings. Overall mean age at first kidding was in accordance with the findings of Rume *et al.* (2011), Faruque *et al.* (2010), Das *et al.* (2008) in Black Bengal goat and Singh Bariha *et al. (*2008) in Ganjam goat. Higher estimate of age at first kidding was reported by Hasan *et al.* (2014), Haque *et al.* (2013) and Naderi *et al.* (2008) in Black Bengal goat and Rao *et al.* (2009) in Ganjam goat. Lower values for the same trait were reported by Faruque *et al.* (2010) in Black Bengal goat.

The present finding indicated that significantly lower age at first kidding was related with TfBC, TfBB and TfCC phenovariants of transferrin may have some selective advantage. The combination of phenovariants observed in the research findings of Osman (1967) also had similar impact on age at first lambing in certain environment in Desert sheep of Sudan. However, the present finding was not in agreement with the findings of Khanra (1988) in Black Bengal goat, Ghatak (2001) and Yadav *et al.* (2012) in Garole sheep; Erokhin and Bashkeeva (1978) in Kuibyshev sheep. Although, Khanra (1988) reported significant relationship of TfBC and TfAA phenovariants with lower age at fourth kidding.

Finding of age at first kidding according to different colour varieties in this study was to some extent differ from Acharya (1992) who reported age at first kidding was maximum in black (384 days) followed by brown (373 days) and white (356 days) coat colour goat whereas in this present study age at first kidding was maximum in white variety goat i.e. 12.899 ± 0.231 months or near about 388 days.

The combination of black and white colour variety and its interaction with TfBC phenovariant performed better in terms of lower age at first kidding. However, this information could not be compared due to non-availability of such type of work in small ruminants.

Post-partum heat period (day)

It was observed that Black Bengal does require on an average 42.554 ± 0.658 days post-partum heat period (Table 1). It was observed that mean post-partum heat period was recorded maximum in TfBC phenotype followed by TfAC, TfBB, TfAB, TfAA and TfCC phenotypes, respectively. The average post-partum heat period of Black Bengal does estimated in the present investigation were 40.562 ± 1.259 days for TfAA, 42.159 ± 0.977 days for TfAB, 44.213 ± 2.136 days for TfAC, 43.604 ± 2.833 days for TfBB, 44.520 ± 1.766 days for TfBC, and 40.267 ± 2.220 days for TfCC phenovariant. The Black Bengal does having TfCC phenovariant attained post-partum heat almost four days earlier than TfBC phenovariant for this trait. Although, there were ample differences of post-partum heat period among the different categories of does but statistical analysis failed to show any significant effect of transferrin phenovariants on this trait of Black Bengal does under study.

The mean post-partum heat period was recorded maximum for brown colour variety (45.710 ± 1.906 days) followed by white (42.426 ± 1.734 days), black (41.707 ± 0.752 days) and black and white variety (40.375 ± 1.783 days) in Bengal goats (Table 1). But it was observed that there was no significant effect of colour on post-partum heat period. Result of present finding indicated that black and white coat colour does required minimum number of days for this trait among the four colour varieties of Black Bengal does under study.

From the estimated result, it was observed that the mean post-partum heat period was highest for does having brown colour with TfAC phenotype (57.00 ± 2.83 days) and lowest in the animals with black and white colour and TfAC phenotype (35.0 ± 2.886 days). Post- partum heat period ranged from 40.000 ± 1.571 days for TfAA to 43.571 ± 3.400 days for TfCC phenovariant among the black colour variety. It was varied from 35.0 ± 2.886 days for TfAC to 47.5 ± 2.5 days for TfBC phenovariant among the black and white colour variety. It was varied from 36.0 ± 3.422 days for TfAA to 57.0 ± 2.83 days for TfAC phenovariant among the brown colour variety. It was varied from 37.5 ± 7.5 days for TfCC to 45.0 ± 3.273 days for TfAA phenovariant among the white colour variety. The effect of interaction of phenovariants and coat colour varieties had no significant effect on average post-partum heat period in Black Bengal does. Although, it was observed that the animals having TfCC phenovariant and black and white coat colour independently showed lower post-partum heat period but their interaction effect was not in accordance with the independent effect.

The mean post-partum heat period in Black Bengal goat was estimated as 42.554 ± 0.658 days in the present study which differs from the earlier research findings of 36.0±1.254 days (Miah *et al.* 2016) and 33.1±5.4 days (Faruque *et al.* 2010) in Black Bengal goat. However, much higher value of 63.25±24.32 days (Miah *et al.* 2016)

in Jamunapari goat and 77.0 ± 4.04 days (Islam *et al.* 2009) in Black Bengal goat for post-partum heat period were observed in semi-intensive farming system.

Average kidding size (number)

In this investigation the overall average kidding size was found to be 2.290 ± 0.047 in Black Bengal does (Table). However, the mean number of kids per kidding was produced maximum by does with TfCC (2.841 ± 0.203) followed by TfAB (2.222 ± 0.081), TfAC (2.189 ± 0.124), TfBC (2.189 ± 0.127), TfAA (2.161 ± 0.103) and TfBB (2.139 ± 0.127) type animals, respectively. Present research finding revealed that the TfCC phenovariant was found to be more prolific compared to other phenovariants of transferrin in Black Bengal does under study.

It can also be observed that the average kidding size in Black Bengal does was maximum in white variety (2.461 ± 0.091) followed by black and white (2.338 ± 0.134), black (2.235 ± 0.067) and brown (2.126 ± 0.113), respectively.

However, the highest average kidding size have been produced by does of white colour with TfCC phenotype (3.250 ± 2.000) and lowest number of kids produced by combination of brown colour with TfAA phenotype (1.718 ± 0.247).

Among the black colour variety the average number of kids per kidding ranged from 2.166 ± 0.274 for TfBB to 2.329 ± 0.135 for TfAA phenovariant. Similar ranges were observed for 2.00± 0.06 for TfBB to 2.915 ± 0.585 for TfCC phenovariant among the black and white colour variety while in brown colour variety, it was varied 1.718 ± 0.247 for TfAA to 2.915 ± 0.585 for TfCC phenovariant. The estimated value for average number of kids per kidding in Black Bengal does were 1.839 ± 0.818 for TfAC to 3.250 ± 2.0 for TfCC phenovariant among the white colour variety.

Statistical analysis revealed that no significant relationship of phenovariants, colour varieties and interaction of both was observed with respect to average kidding size in Black Bengal does. It was observed that the animals having TfCC phenovariant and white coat colour independently showed highest average kidding size had similar result when interaction of both were taken into consideration.

The result of the average kidding size of 2.290 ± 0.047 in this present investigation was in accordance with the findings of Miah *et al.* (2016) in Black Bengal goat. However, lower estimates of average kidding size were reported by Miah *et al.* (2016) in Jamunapari goat and Naderi *et al*. (2008) and Chowdhury *et al.* (2002) in Black Bengal goat under semi-intensive system of farming.

In this present investigation, overall results depicted that there was no significant relationship of transferrin types with most of the reproductive traits except age at puberty and age at first kidding where transferrin phenovariants had significant effect. These may be due to the unequal distribution of different transferrin phenotypes in the population taken for this study, *viz*., TfAA, TfAB and TfAC were found in more than two-third of the samples and other one-third were distributed in TfBB, TfBC and TfCC phenotypes. However, a precise result may be obtained with large population size with equal distribution of observation under each phenovariants.

Conclusion

Least square analysis of data pertaining to different reproductive traits of Black Bengal does depicted that the TfBC phenovariant were significantly related with lower age at puberty, lower estrous period and lower age at first kidding followed by TfCC phenovariant. On the other hand, mixed variety of Black and white colour also performed better for those above mentioned reproductive traits in Black Bengal does. Thus, it will become helpful in selecting the right one with superior genotype as the polymorphic traits will act as a biochemical marker. Even so, in order to obtain a more definite conclusion it is required to conduct a research work on large sample of Black Bengal goats in their native tract.

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