Morphological Features and Growth Traits of Half Sib Local Pabna Calves up to Yearling Stages

M.A.I. Talukder¹, M. Shahjahan², S. Munira³, S. Rahman³, A.K.F.H. Bhuiyan³

ABSTRACT

Background: Usually morphological features and growth traits are used in breed characterization. The research was performed to reveal the phenotypic and growth traits of half sib Pabna calves up to yearling stages and to reveal their association with selection regarding body size and morphological features.

Methods: Data of phenotypic measures from both body and head parts and growth traits were collected from 18 and 22 half sib Pabna calves, respectively. The body weight of newborn calves and respective dams were recorded separately. Each calf was allowed to drink 10% of milk for individual's body weight from respective dam twice per day at calf shed.

Result: Linear increasing trend observed in all morphological features from birth to yearling stages for both body and head characteristics of Pabna calves in which heart girth (63.33±1.31 cm at birth and 91.83±2.18 cm at pre-weaning), wither height (84.17±0.60 cm at pre-weaning), carpal circumference (10.50±0.50 cm at birth), mouth circumference (21.33±0.33 cm at birth and 26.58 cm at pre-weaning) and head length (30.08±0.99 cm at pre-weaning) had significant differences (<0.05) in male calves compared to female. The effect of calves’ birth weight deferred significantly (p<0.05) for body length, heart girth, abdominal circumference, wither height and tail length in the calves’ group having ≥20 kg of birth weight compared to <20 kg. Body weight of Pabna calves also showed linear fashion from birth (19.56±2.11 kg) to yearling stages (112.33±3.30 kg) including moderate correlation at first (53%) and twelfth (48%) month and weak at weaning (7%) stages. The sex and birth weight of calf had significant effects (p<0.05) up to pre-weaning stage of calf but its continuation was not followed up to yearling stages.

Key words: Cattle, Measurement, Native breed, Phenotype, Skeletal structure.

INTRODUCTION

Phenotypic features and growth traits are important parameters for breed characterization and performance evaluation as those traits can be used as selection criteria for screening the desire individual. Pabna cattle are one of the most promising local varieties for milk production and growth among the available cattle varieties in Bangladesh. According to FAO (2012) phenotypic characterization contributes to the improvement of animal genetic resources in the context of country-level implementation. The morphological features were not varied between local Pabna cattle populations except body length, height at wither, pelvic length, tail dock and mouth circumference in adult (Talukder et al. 2017) while heart girth and mouth circumference in half sib baby calves (Talukder et al. 2019). Phenotypic characterization of Pabna cattle especially in the yearling stages is not available which could be useful in selecting desire cattle in local Pabna cattle herd in future. Therefore, the study was conducted to reveal the phenotypic and growth traits of half sib Pabna calves up to yearling stages to select the comparative best cattle based on increasing pattern of body size and morphological features towards the development of a uniform Pabna cattle herd.

MATERIALS AND METHODS

Data of various preselected phenotypic measures from both body (ten features) and head (five features) parts and growth parameters for breed characterization and performance evaluation among the available cattle varieties in Bangladesh. According to FAO (2012) phenotypic characterization contributes to the improvement of animal genetic resources in the context of country-level implementation. The morphological features were not varied between local Pabna cattle populations except body length, height at wither, pelvic length, tail dock and mouth circumference in adult (Talukder et al. 2017) while heart girth and mouth circumference in half sib baby calves (Talukder et al. 2019). Phenotypic characterization of Pabna cattle especially in the yearling stages is not available which could be useful in selecting desire cattle in local Pabna cattle herd in future. Therefore, the study was conducted to reveal the phenotypic and growth traits of half sib Pabna calves up to yearling stages to select the comparative best cattle based on increasing pattern of body size and morphological features towards the development of a uniform Pabna cattle herd.

Materials: The research was performed in the yearling stages with 18 and 22 half sib Pabna calves, respectively. The body weight of newborn calves and respective dams were recorded separately. Each calf was allowed to drink 10% of milk for individual's body weight from respective dam twice per day at calf shed.

Methods: Data of phenotypic measures from both body and head parts and growth traits were collected from 18 and 22 half sib Pabna calves, respectively, using measuring tape and digital weighing balance up to 12 months of calving at BLRI Regional Station, Baghabari during March, 2018 to June, 2019. The body weight of newborn calves and respective dams were recorded separately. Further body weights of calves were recorded in each consecutive measuring period of one month’s interval (DDRP-BLRI solution, SourceTrace System, Massachusetts, USA). In case of phenotypic measurements of calves, same side and direction were followed for all individuals in each time. Each calf was allowed to drink 10% of milk for individual's body weight from respective dam twice per day at calf shed.

Results: Linear increasing trend observed in all morphological features from birth to yearling stages for both body and head characteristics of Pabna calves in which heart girth (63.33±1.31 cm at birth and 91.83±2.18 cm at pre-weaning), wither height (84.17±0.60 cm at pre-weaning), carpal circumference (10.50±0.50 cm at birth), mouth circumference (21.33±0.33 cm at birth and 26.58 cm at pre-weaning) and head length (30.08±0.99 cm at pre-weaning) had significant differences (<0.05) in male calves compared to female. The effect of calves’ birth weight deferred significantly (p<0.05) for body length, heart girth, abdominal circumference, wither height and tail length in the calves’ group having ≥20 kg of birth weight compared to <20 kg. Body weight of Pabna calves also showed linear fashion from birth (19.56±2.11 kg) to yearling stages (112.33±3.30 kg) including moderate correlation at first (53%) and twelfth (48%) month and weak at weaning (7%) stages. The sex and birth weight of calf had significant effects (p<0.05) up to pre-weaning stage of calf but its continuation was not followed up to yearling stages.

Key words: Cattle, Measurement, Native breed, Phenotype, Skeletal structure.
RESULTS AND DISCUSSION
Morphological features of half sib local Pabna calves
Linear increasing trend identified in all morphological features from birth to yearling stages for both body and head characteristics of Pabna calves in which heart girth (63.33±1.31 cm at birth and 91.83±2.18 cm at pre-weaning), wither height (84.17±0.60 cm at pre-weaning), carpal circumference (10.50±0.50 cm at birth), mouth circumference (21.33±0.33 cm at birth and 26.58 cm at pre-weaning) and head length (30.08±0.99 cm at pre-weaning) had significantly higher (p<0.05) measurements in male calves compared to female (Table 1). These data suggested that the phenotypic features of male progeny over female at pre-weaning stages of yearling local Pabna cattle for heart girth, wither height, mouth circumference and head length could be used as selection parameters for this initial stage (data of non-significant features are not shown) but its continuation was not similar for the next measuring period.

Similarly, the effect of calves’ birth weight deferred significantly (p<0.05) for body length (77.25±1.54 cm at pre-weaning), heart girth (91.88±1.46 cm at pre-weaning), abdominal circumference (104.67±0.88 cm at post-weaning), wither height (83.88±1.17 cm at pre-weaning) and tail length (50.50±1.40 cm at pre-weaning) in the calves’ group having >20 kg of birth weight compared to <20 kg (Table 2). These data indicated that birth weight of calves might have positive association with a number of morphological features at pre-weaning stage but its consequences were not continued for the following stages. Thus, birth weight might not be a useful tool for selecting future weight gain.

Correlation on growth traits of Pabna calves
Body weight of Pabna calves also showed linear fashion from birth (19.56±2.11 kg) to yearling stages (112.33±3.30 kg) including moderate correlation at first (53%) and twelfth (48%) month and weak at weaning (7%) stages (Fig 1). The study of Das et al. (2003) and Hoque et al. (1999) observed 16.58 and 17.9 kg birth weight, respectively, in local Pabna cattle at Baghabrighat Milk Vita areas which was comparatively lower than our findings. Another study by Mostari et al. (2017) in local Pabna cattle known as BCB-1 cattle breed found 18.40, 50.10, 91.62, 139.40 and 194.70 kg in birth, 3rd month, 6th month, 9th months and 12th months, respectively, raised for beef production. However, the higher growth performance after weaning than our findings might be associated with special feeding regime of those local Pabna progeny. The sex and birth weight of calf had significant effects (p<0.05) up to pre-weaning stage of calf (Table 3). These data suggested the growth rate patterns of local Pabna calves and also to provide special care through feeding management during adverse situation.

Seasonal effects on growth traits of calves
It was observed that calves birth in Winter (22.45±0.19) attained higher body weight (p<0.001) compared to other seasons (Table 4) while similar observation observed at post

Table 1: Effect of sex on morphological features of half sib Pabna cattle calves up to weaning period.

| Morphological features                | Sex          | At birth (n=18; M-6, F-12) | Pre-weaning (n=17; M-6, F-11) | Weaning (n=14; M-4, F-10) |
|---------------------------------------|--------------|---------------------------|-------------------------------|--------------------------|
|                                       |              | Mean                      | SE                           | Mean                     | SE                           |
| **Body characteristics (cm)**         |              |                           |                              |                          |
| Heart girth (HG)                      | Male         | 63.33                     | 1.31                         | 91.83                    | 2.18                         | 101.00 | 2.58 |
|                                       | Female       | 59.42                     | 0.74                         | 86.50                    | 1.00                         | 102.90 | 1.92 |
|                                       | *P value*    | 0.013                     | 0.022                        | 0.594                    |                              |        |     |
| Wither height (WH)                    | Male         | 65.83                     | 1.01                         | 84.17                    | 0.60                         | 90.50  | 1.71 |
|                                       | Female       | 64.58                     | 0.69                         | 79.77                    | 0.69                         | 88.15  | 0.86 |
|                                       | *P value*    | 0.317                     | 0.000                        | 0.196                    |                              |        |     |
| Carpal circumference (CC)             | Male         | 10.50                     | 0.50                         | 11.17                    | 0.17                         | 12.13  | 0.31 |
|                                       | Female       | 9.25                      | 0.22                         | 10.86                    | 0.14                         | 12.05  | 0.41 |
|                                       | *P value*    | 0.016                     | 0.193                        | 0.915                    |                              |        |     |
| **Head characteristics (cm)**         |              |                           |                              |                          |
| Mouth circumference (MC)              | Male         | 21.33                     | 0.33                         | 26.58                    | 0.76                         | 31.00  | 1.00 |
|                                       | Female       | 20.17                     | 0.27                         | 24.73                    | 0.48                         | 29.20  | 0.74 |
|                                       | *P value*    | 0.020                     | 0.047                        | 0.204                    |                              |        |     |
| Head length (HL)                      | Male         | 21.25                     | 0.40                         | 30.08                    | 0.99                         | 33.88  | 0.83 |
|                                       | Female       | 21.08                     | 0.36                         | 27.45                    | 0.35                         | 32.70  | 0.26 |
|                                       | *P value*    | 0.779                     | 0.007                        | 0.094                    |                              |        |     |
Morphological Features and Growth Traits of Half Sib Local Pabna Calves up to Yearling Stages

weaning stage in Summer (64.85±1.84). The average daily gains (ADG) of calf showed highest (449.33±17.07 g) and lowest (261.35±12.96 g) values at first and twelfth month of birth, respectively (Table 5). In pre-weaning stage, the ADG observed highest in Winter season (471.11±20.95 g) while at post-weaning stage in Summer (333.88±13.44 g) season (Table 6). The study of Mostari et al. (2017) observed seasonal variation in calves' birth and pre-weaning stage which agreed with our findings. It might be the reason of feeding regime through abundant green grass from Winter to Summer when skeletal muscle development (Shahjahan,

Table 2: Effect of birth weight on morphological features (cm) in different weaning stages of half sib Pabna cattle calves.

| Morphological features | Birth weight of calf | Pre-weaning (n=17; <20 kg-9, ≥20 kg-8) | Weaning (n=14; <20 kg-9, ≥20 kg-5) | Post weaning (n=12; <20 kg-9, ≥20 kg-3) |
|------------------------|---------------------|--------------------------------------|-----------------------------------|--------------------------------------|
|                        | Mean | SE | Mean | SE | Mean | SE | Mean | SE | Mean | SE |
| Body length (BL)       |       |    |       |    |       |    |       |    |       |    |
| <20 kg                 | 72.61 | 1.27 | 87.44 | 1.00 | 94.22 | 1.18 |
| ≥20 kg                 | 77.25 | 1.54 | 89.00 | 1.87 | 92.67 | 3.28 |
| t-test                 | 0.034 |    | 0.434 |    | 0.577 |    |
| Heart girth (HG)       |       |    |       |    |       |    |       |    |       |    |
| <20 kg                 | 85.28 | 0.92 | 103.00 | 1.96 | 111.78 | 1.59 |
| ≥20 kg                 | 91.88 | 1.46 | 101.20 | 2.62 | 105.67 | 2.33 |
| t-test                 | 0.001 |    | 0.592 |    | 0.076 |    |
| Abdominal circumference (AC) |       |    |       |    |       |    |       |    |       |    |
| <20 kg                 | 90.44 | 1.09 | 103.44 | 2.36 | 112.33 | 1.32 |
| ≥20 kg                 | 91.88 | 3.07 | 103.00 | 3.11 | 104.67 | 0.88 |
| t-test                 | .652 |    | .912 |    | .010 |    |
| Wither height (WH)     |       |    |       |    |       |    |       |    |       |    |
| <20 kg                 | 79.00 | 0.54 | 88.94 | 0.84 | 95.89 | 1.10 |
| ≥20 kg                 | 83.88 | 1.17 | 88.60 | 1.81 | 93.33 | 0.88 |
| t-test                 | .001 |    | .846 |    | .234 |    |
| Rump length (RL)       |       |    |       |    |       |    |       |    |       |    |
| <20 kg                 | 23.72 | 0.75 | 21.33 | 0.37 | 22.22 | 0.64 |
| ≥20 kg                 | 19.00 | 0.46 | 19.80 | 0.73 | 23.33 | 0.33 |
| t-test                 | .000 |    | .059 |    | .360 |    |
| Tail length (TL)       |       |    |       |    |       |    |       |    |       |    |
| <20 kg                 | 44.56 | 0.33 | 55.78 | 1.27 | 62.44 | 1.31 |
| ≥20 kg                 | 50.50 | 1.40 | 56.60 | 1.21 | 63.00 | 2.52 |
| t-test                 | .001 |    | .679 |    | .840 |    |

Table 3: Effect of sex and birth weight in different weight measuring periods of half sib Pabna calves.

| Period of measurement | At birth (o m) | Pre-weaning (3rd m) | Weaning (6th m) | Post-weaning (9th m) |
|-----------------------|---------------|---------------------|-----------------|---------------------|
|                       | Sex           |                     |                 |                     |
|                       | Male          | 21.10±0.64 (7)*     | 61.23±2.14 (6)* | 88.74±3.58 (5)      | 102.73±5.20 (3)     |
|                       | Female        | 18.84±0.45 (15)*    | 53.69±1.81 (12)*| 82.68±3.17 (10)     | 103.03±5.61 (10)    |
|                       | P value       | 0.010               | 0.023           | 0.263               | 0.979               |
|                       | Birth weight of calf |               |                 |                     |
| <20 kg                | -             | 52.81±1.55 (9)      | 83.84±3.47 (9)  | 105.17±5.70 (9)     |
| ≥20 kg                | -             | 59.60±2.41 (9)      | 85.98±3.65 (6)  | 98.00±6.51 (4)      |
| P value               | -             | 0.031               | 0.688           | 0.474               |

Fig 1: Body weight of Pabna calves up to yearling stages (a) including correlation (b) among the periods.
2015) occurred properly in early embryonic stage of fetus in the pregnant cows.

CONCLUSION
The variations of phenotypic feature and growth trait were not considered as strong indicators for screening individuals up to yearling stages in half sib local Pabna calves. However, large sample size and calves of multiple sires including more unique management could be applied to check the hypothesis again for further clarification.

ACKNOWLEDGEMENT
The authors are grateful to the Dairy Development Research Project of Bangladesh Livestock Research Institute for required funding to conduct this research work.

REFERENCES
Das, P.K., Ali, S.Z., Islam, A.B.M.M. and Roy, B.K. (2003). A comparative study of productive and reproductive performance and estimates of heritability for economic traits in different genetic groups of cattle available at Baghabarigha Milk Pocket Area of Bangladesh. Online Journal of Biological Sciences. 3: 726-740.

FAO. (2012). Phenotypic characterization of animal genetic resources.

Table 4: Effect of calves’ birth season on body weight up to post weaning stage.

| Period of measurement | At birth (o m) | Pre-weaning (3rd m) | Weaning (6th m) | Post-weaning (9th m) |
|-----------------------|---------------|---------------------|-----------------|----------------------|
| Summer                | 18.48±0.33 (13)a | 53.27±1.25 (10)b | 85.60±2.72 (9) | 108.34±3.39 (9) |
| Rainy                 | 20.06±0.89 (5)b | 54.90±4.36 (4)b | 82.60±7.45 (4) | 90.85±10.47 (4) |
| Winter                | 22.45±0.19 (4)a | 64.85±1.84 (4)a | 84.85±5.55 (2) | -                   |
| Overall               |                |                     |                 |                     |

Table 5: Diversity in average daily gain (ADG) up to yearling stage of half sib Pabna cattle calves.

| Growth measuring period (m) | n  | Mean  | SE  | Minimum | Maximum | P value |
|-----------------------------|----|-------|-----|---------|---------|---------|
| ADG_0-1m                    | 20 | 449.3340* | 17.07154 | 326.67 | 600.00 |
| ADG_0-2m                    | 18 | 424.1939ab | 14.90343 | 325.00 | 543.33 |
| ADG_0-3m                    | 18 | 404.4806abc | 14.63678 | 305.56 | 508.89 |
| ADG_0-4m                    | 18 | 399.9206abc | 16.42658 | 281.67 | 525.83 |
| ADG_0-5m                    | 17 | 389.5412abc | 14.31756 | 283.33 | 491.33 |
| ADG_0-6m                    | 15 | 362.7147cde | 13.38038 | 265.00 | 448.33 |
| ADG_0-7m                    | 14 | 346.5400def | 12.55406 | 266.19 | 453.81 |
| ADG_0-8m                    | 14 | 311.9729def | 16.81383 | 180.83 | 413.75 |
| ADG_0-9m                    | 13 | 311.0195def | 16.73964 | 175.93 | 396.67 |
| ADG_0-10m                   | 13 | 283.3154def | 13.29371 | 172.33 | 358.67 |
| ADG_0-11m                   | 12 | 261.3467 | 12.96060 | 163.33 | 339.70 |
| ADG_0-12m                   | 9  | 245.7678 | 14.22199 | 195.55 | 327.12 |

Table 6: Seasonal effect of birth on different weaning stages of Pabna cattle calves.

| Period of measurement | Pre-weaning (3rd m) | Weaning (6th m) | Post-weaning (9th m) |
|-----------------------|---------------------|-----------------|----------------------|
| Summer                | 387.62±13.86 (10)a | 374.46±14.88 (9) | 333.88±13.44 (9)a |
| Rainy                 | 380.00±40.84 (4)b  | 343.89±37.39 (4) | 259.82±35.97 (4) |
| Winter                | 471.11±20.95 (4)a  | 347.50±30.28 (2) | - |
| Overall               |                    |                 |                     |

FAO Animal Production and Health Guidelines No. 11. Rome. Hoque, M.A., Amin, M.R. and Hussen, M.S. (1999). Dairy potential of Pabna cows and crossbreds with Sahiwal and Friesian and within-and between-breed sire effects. Asian-Australasian Journal of Animal Sciences. 12: 161-164.

Khan, M.K.I., Blair, H.T. and Lopez-Villalobos, N. (2017). Modelling genetic improvement of Pabna cattle in Bangladesh. Journal of Applied Animal Research. 45: 239-246.

Mostari, M.P., Khan, M.Y.A., Roy, B.K., Hossain, S.M.J. and Huque, K.S. (2017). Growth performance of yearling F1 progeny of different crossbred beef cattle. Bangladesh Journal of Animal Science. 46: 82-87.

Shahjahan, M. (2015). Skeletal muscle development in vertebrate animals. Asian Journal of Medical and Biological Research. 1: 139-148.

Talukder, M.A.I., Shahjahan, M., Islam, M.S. and Munira, S. (2017). Diversity in morphology and pigmentation patterns of local Pabna cattle in Bangladesh. Research in Agriculture Livestock and Fisheries. 4: 201-208.

Talukder, M.A.I., Shahjahan, M., Munira, S., Rahman, S.M., Ali, M.Y., Salahuddin, M., Miah, M.A.H., Billah, M.M., Habib, M.R. and Bhuyan, A.K.F.H. (2019). Variation of morphological features and growth traits in half sib baby calves of Pabna cattle in Bangladesh. Asian Journal of Medical and Biological Research. 5: 52-55.