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Phenotypical characterization (Qualitative Traits) of indigenous chickens (*Gallus gallus domesticus* L.) at Rajshahi City Corporation (RCC) area in Bangladesh

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Abstract

The study was conducted to assess the qualitative traits of indigenous chickens. A total of 212 chickens were used to conduct this research and the qualitative traits were feather type, head shape, plumage colour, shank colour, comb colour and earlobe colour. The results revealed that the normal feather type (95.25%) was dominant over the naked neck. Plain head was 69.34% followed by cock's comb and crested head shape. Diversities in plumage colour showed multicolour with highest value (25%) among golden mixed, black brown, white black, black and white. White shank (38.21%) was dominant over the black, yellow and brown. The single comb frequency was 93.87% and the others were rose, pea and cushion. The red ear lobe percentage (63.68%) was higher than the white ear lobe traits. These data might be helpful in improvement of indigenous chickens for consumer choice and restoration of genetic resources from their genetic loss.

Keywords: Indigenous, percentage, phenotype, qualitative trait

1. Introduction

The indigenous chickens are reared popularly by poor village people for resistance to diseases and heat stress, good adaptive responses to environment, and ability to survive with low input of feed with low productivity (Hamid, 2019^[21]; FAO, 2008^[17]; Barua and Howlider, 1990^[7]). They are less productive but have certain attributes of economic and cultural significance (Mengesha and Tsega, 2011^[26]). Also, they are remarkable for their meat tenderness and special taste of meat and nutritious eggs (Chowdhury, 2012^[15]; Ahmed and Ali, 2007^[2]) and are very much popular to rural, peri-rural and urban people (Chowdhury, 2012^[15]). Indigenous chickens are preferred to exotic chickens because of their pigmentation, taste, flavour and leanness (Halima *et al.*, 2007^[20]). The chicken germplasms of Bangladesh is composed of indigenous or native type, exotic type, crossbred type and commercial hybrid (Hamid, 2019^[21]). Again, the indigenous chicken population is comprised of a number of breeds/types such as Non-descript Desi (ND), Naked Neck (NN), Aseel (AS), Hilly (H), Native Dwarf, Jungle Fowl and Frizzled Plumage (Bhuiyan *et al.*, 2005^[11]; Das *et al.*, 2008^[16]). Among them the nondescript deshi chickens are distributed throughout the country (Okada *et al.*, 1987^[31]) and naked neck distribution is comparatively very thin (Hamid, 2019^[21]).

Bangladesh has a large human population and to fulfill the need of animal protein for them many efforts have been taken to sustain commercial hybrid broiler and layer chicken. The indigenous chicken population has been undergoing genetic erosion since the 1960s through continuous indiscriminate crossing with improved exotic stock which were imported from developed countries (Bhuiyan *et al.*, 2005^[11]). In developing countries, phenotypically the indigenous chickens are poorly characterized which has led to the loss of poultry genetic resources (Brown *et al.*, 2017^[14]; Negassa *et al.*, 2014^[30]). So, the improvement and conservation programs of indigenous chickens are very important to save them from their genetic loss. Recently, attention has been given to the improvement and conservation of native chickens due to higher preference of consumers and higher price than the exotic, crossbred and

commercial hybrids (Hamid, 2019 [21]). The identification and characterization of the chicken genetic resources should be made which requires information on possession of phenotypic characters of current or future value (Weigend and Romanov, 2001 [37]).

Phenotypic characterization is the first step required to utilize and conserve indigenous livestock breeds (Maharani *et al.*, 2021 [25]). It allows researchers to identify phenotypic variation present within and between breeds, which could be valuable for improvement and selection programs for particular economic traits (Maharani *et al.*, 2019 [24]). Furthermore, efficient utilization of an indigenous breed depends primarily on accurate knowledge of its physical characteristics that distinguish it from other breeds or species (Maharani *et al.*, 2021 [25]).

The assessment of phenotypic characters has been used as a critical panel for selection of breeds for economic traits (Onasanya *et al.*, 2018 [32]; Sarkar, *et al.*, 2014 [34]; Adewunmi, *et al.*, 2006 [1]; Ozoje and Herbert, 1997 [33]). The unpredictable demands for poultry products and likely climatic variation in the future, as well as a necessity for the sustainable use of indigenous chickens, the evaluation and monitoring of the phenotypic characteristics of chickens are highly recommended (Maharani *et al.*, 2021 [25]). The present and future improvement and sustainable utilization of indigenous chickens are dependent upon the availability of the genetic variations (Benitez, 2002 [10]).

The information of phenotypic characteristics of indigenous chickens in Bangladesh are not enriched which is necessary to make genetic improvement and selection programs for phenotypic characters of economic importance. Therefore, there is a need to determine the phenotypic characteristics of indigenous chickens to sustainably utilize and conserve them. Furthermore, the phenotypic characterization is a useful approach because it is simple, easy, fast, and cost-effective (Maharani *et al.*, 2021 [25]). Thus, the present study was undertaken to phenotypically characterize the indigenous chicken populations at Court, Katakhal and Uposhahar areas under Rajshahi City Corporation in Bangladesh.

2. Materials and Methods

2.1 Selection of study area

The study was carried out at three different places in Rajshahi City Corporation namely Court Area (CA), Katakhal Area (KA), and Uposhahar Area (UA). The indigenous chickens were 50, 80 and 82 in number in CA, KA and UA areas with different phenotypes available here in different villages at population levels. Thus, these places were selected to conduct the research to get more phenotypic characteristics from large chicken populations.

2.2 Study period

The research work was conducted from June 2021 to May 2022 to observe qualitative phenotypic characteristics of indigenous chickens from the study areas.

2.3 Management of chicken

The indigenous chickens were reared in rural areas by rural farmers especially village women according to traditional scavenging system. The chicken shelters were mostly made of bricks, wood, bamboo, corrugated sheeting, and plastic in village.

2.4 Data collection

The selected areas visited to investigate the different qualitative phenotypic traits of indigenous chickens. All of them were individually observed and data on the phenotypic characteristics like feather type, head shape, plumage color, shank color, comb types and earlobe color were recorded.

2.5 Measurement of phenotypic traits

In this survey, information on the phenotypic characteristics of indigenous chicken types was recorded by visual appraisal of the appearance of the indigenous chicken types from a total of 212 individual chickens.

2.6 Data analysis

The qualitative data were analyzed by descriptive statistics *i.e.*, the percentage of the phenotypic characteristics from total number of chickens in each selected site and overall from all (three) selected sites (CA, KA and UA).

3. Results

Phenotypes are traits or characteristics of an organism that we can observe and they can be caused by genes or environmental factors, or a combination of both. Phenotypic variation is the variability in phenotypes which exists in a population. The different phenotypes are shown in Fig. 1 and data on phenotypic variability present in the surveyed chickens' (indigenous) populations are presented in Table 1. There were three indigenous chicken populations selected from Court Area or CA (50 in number), Katakhal Area or KA (80 in number) and from Uposhahar Area or UA (82 in number) and they were surveyed for the study of phenotypic traits.

All chickens showed the normal feather type 100% in Court Area (CA), 97.5% in Katakhal Area (KA) and 90.24% in Uposhahar Area (UA) and naked necks with zero (0) in CA or with few percentages (2.5% in KA, 9.76% in UA) (Table 1; Graph 1,2,3). The overall percentage for normal feather was 95.28% and naked neck was 4.72% (Table 1; Graph 4).

The head shape of chickens indicated three clear phenotypic groups *viz.* plain, crested and cocks comb. All three populations from three different areas showed high percentages of plain shape (80% in CA, 82.5% in KA, 50% in UA) followed by cocks comb (10%, 17.5%, 45.12%) whereas crested head shape were with low percentages (10%, 0%, 4.88%) (Table 1; Graph 1, 2, 3). The overall percentage for plain head shape was 69.34%, crested head shape 4.24% and cocks comb 26.42% (Table 1; Graph 4).



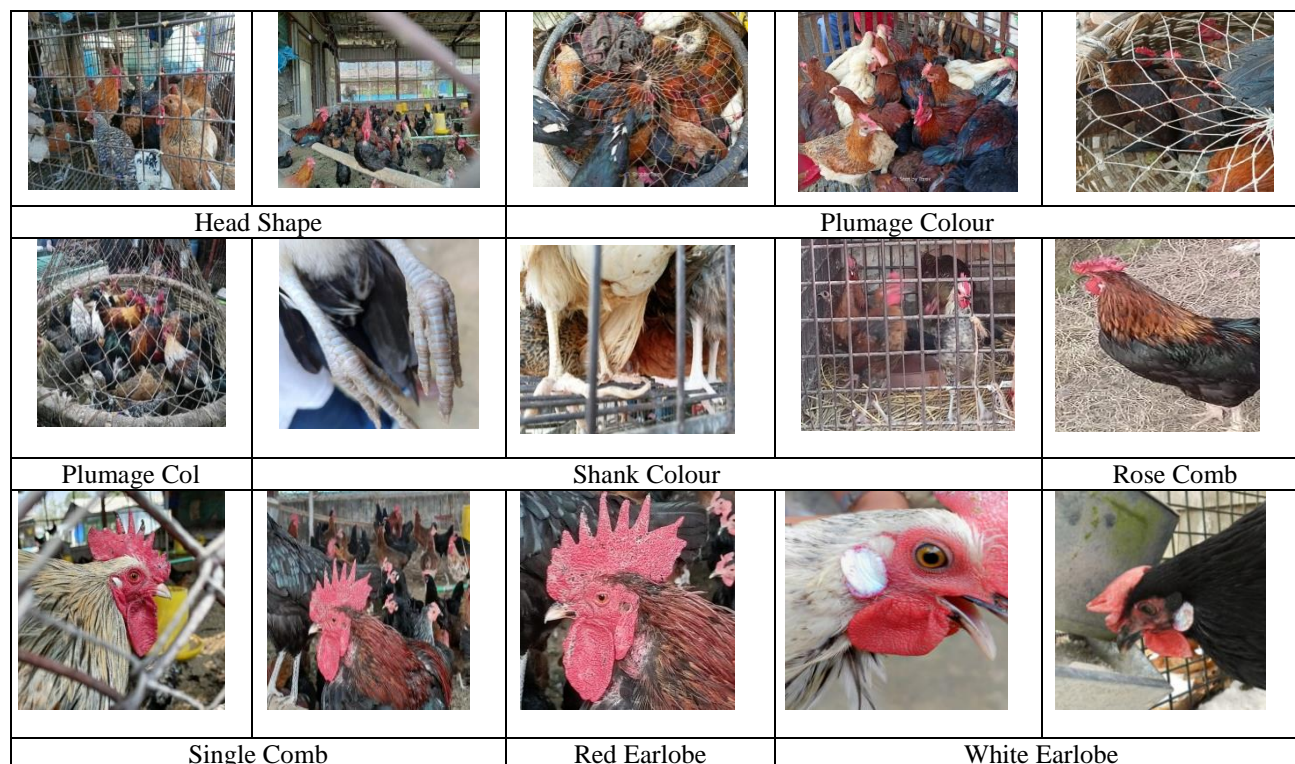


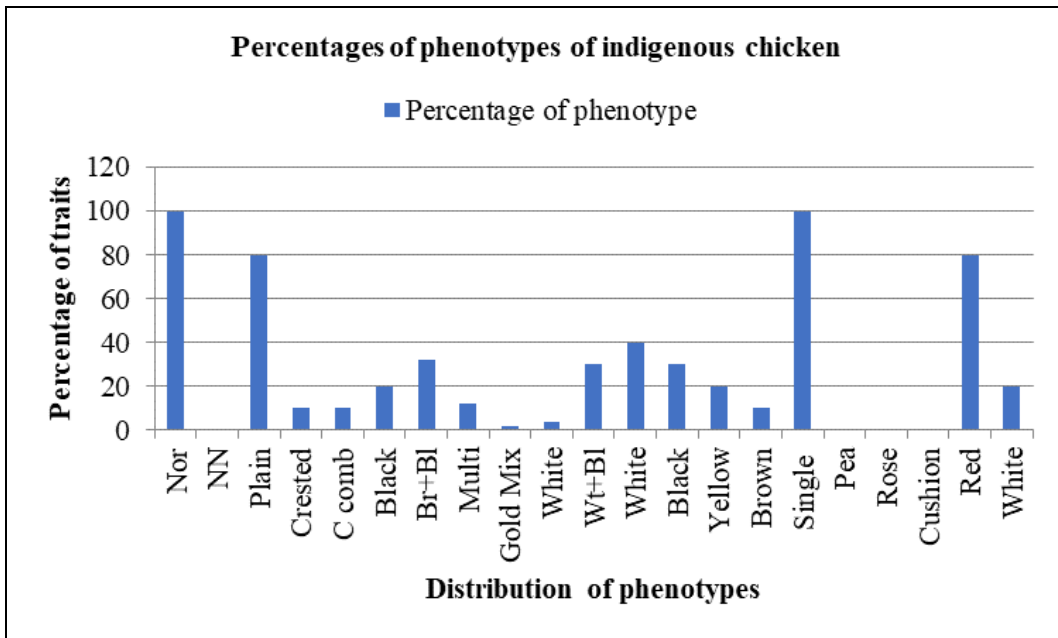
Fig 1: Different phenotypical characteristics of indigenous chickens

Table 1: Phenotypic characteristics of indigenous chickens in Court Area (CA), Katakali Area (KA) and Uposahar Area (UA) in Rajshahi City Corporation (RCC) Area

Phenotypic traits	Distribution	Rajshahi City Corporation (RCC) Area			
		CA (50)	KA (80)	UA (82)	Overall (212)
Feather type	Normal	100(50)a	97.5(78)a	90.24(74)a	95.28(202)a
	Naked Neck	0(0)b	2.5(2)b	9.76(8)b	4.72(10)b
Head shape	Plain	80(40)a	82.5(66)a	50(41)a	69.34(147)a
	Crested	10(5)b	0(0)c	4.88(4)c	4.24(9)c
	Cocks comb	10(5)b	17.5(14)b	45.12(37)b	26.42(56)b
Plumage colour	Black	20(10)c	15(12)c	13.41(11)e	15.56(33)e
	Brown+Black	32(16)a	8.75(7)d	14.63(12)d	16.51(35)c
	Multicolour	12(6)d	38.75(31)a	19.51(16)b	25(53)a
	Golden mixed	2(1)f	26.25(21)b	24.39(20)a	19.81(42)b
	White	4(2)e	3.75(3)f	12.20(10)f	7.08(15)f
Shank colour	White+Black	30(15)b	7.5(6)e	15.85(13)c	16.04(34)d
	White	40(20)a	51.25(41)a	24.39(20)c	38.21(81)a
	Black	30(15)b	13.75(11)c	31.71(26)a	24.53(52)b
	Yellow	20(10)c	31.25(25)b	18.29(15)d	23.58(50)c
Comb type	Brown	10(5)d	3.75(3)d	25.61(21)b	13.68(29)d
	Single	100(50)a	97.5(78)a	86.59(71)a	93.87(199)a
	Pea	0(0)b	2.5(2)b	3.66(3)c	2.36(5)c
	Rose	0(0)b	0(0)c	7.32(6)b	2.83(6)b
Earlobe colour	Cushion	0(0)b	0(0)c	2.44(2)d	0.94(2)d
	Red	80(40)a	75(60)a	42.68(35)b	63.68(135)a
	White	20(10)b	25(20)b	57.32(47)a	36.32(77)b

Numbers outside of parentheses indicated percentages (%) of phenotypic traits and numbers in parentheses chickens surveyed for the characters. Percentage values are indicated

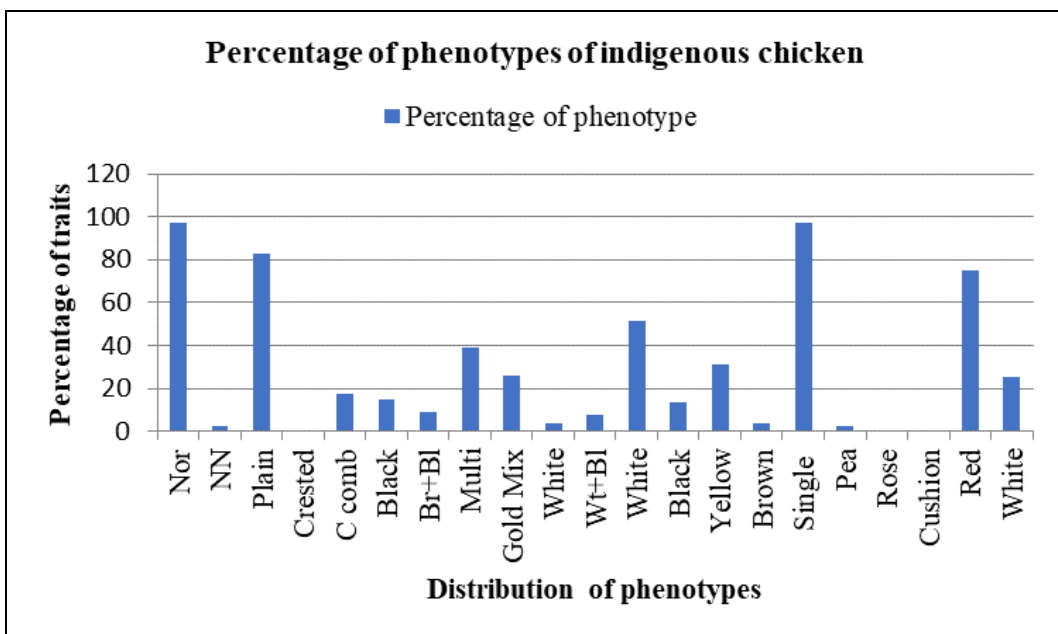
alphabetically (a>b>c>d>e>f) as to show them as descending manner.



Graph 1: Distribution of phenotypic characteristics of indigenous chickens at Court Area (CA) in Rajshahi City Corporation Area.

The plumage colour showed various types that meant the presence of high diversity in the chicken populations under studied areas. Plumage colours were indicated that there were six clear phenotypic groups. They were, black (20%), brownish black (32%), multi-colour (12%), golden mixed (2%), white (4%) and white + black (30%) in Court Area, the same traits in Katakali Area were 15%, 8.7%, 38.75%, 26.25% 3.75% and Upshahar Area were 13.41%, 14.63%, 19.51%, 24.39%, 12.20% (Table 1; Graph 1,2,3). The overall percentages for plumage colour showed 15.56% as black, 16.51% as brownish black, 25% as multicolour, 19.81% as

golden mixed, 7.08% as white and 16.04% as white + black (Table 1; Graph 4). Shank colour was observed and indicated into four types and they were found to be as white (40%), black (30%), yellow (20%) and brown (10%) in Court Area (Table 1; Graph 1). They were also diversified in another two populations with similar distributions *i.e.*, 51.25%, 13.75%, 31.25%, 3.75% in Katakali Area (Table 1; Graph 2) and 24.39%, 31.71%, 18.29%, 25.61% in Upshahar Area (Table 1; Graph 3). The overall percentage values for white, black, yellow and brown were 38.21%, 24.53%, 23.58% and 13.68% (Table 1; Graph 4).



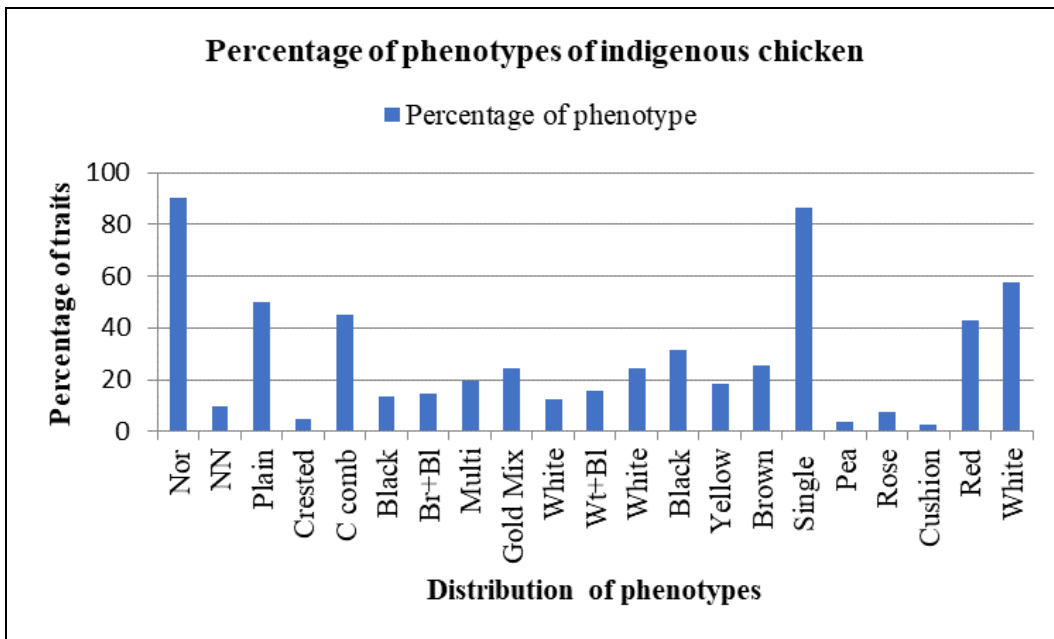
Graph 2: Distribution of phenotypic characteristics of indigenous chickens at Katakali Area (KA) in Rajshahi City Corporation Area.

The comb type was studied and found only single comb type with high percentages in all populations (100% in Court Area, 97.5% in Katakali Area and 86.59% in Upshahar Area) (Table 1; Graph 1, 2, 3). The other comb types were as pea, rose and cushion and their presence was with low frequencies (all with zero in Court Area, 2.5%, 0%, 0% in Katakali

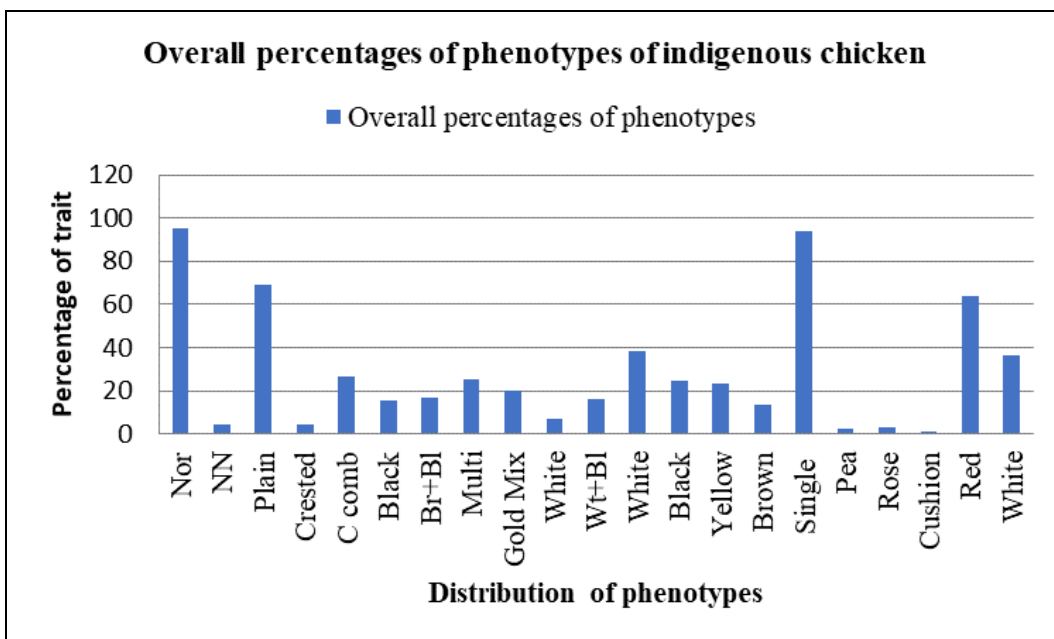
Area, 3.66%, 7.32%, 2.44% in Upshahar Area) (Table 1; Graph 1,2,3). The overall percentages for these combs were 93.87% as single, 2.36% as pea, 2.83% as rose and 0.94% as cushion (Table 1; Graph 4). Earlobe color was with two types *viz.* red and white. The red earlobe colour was 80% and 20% as white in Court Area,

75% as red and 25% as white in Katakali Area, 42.68% as red and 57.32% in Uposahar Area (Table 1; Graph 1, 2, 3).

The overall percentage for red ear lobe was 63.68% and 36.32% (Table 1; Graph 4).



Graph 3: Distribution of phenotypic characteristics of indigenous chickens at Uposahar Area (UA) in Rajshahi City Corporation Area.



Graph 4: Overall distribution (CA, KA and UA) of phenotypic characteristics of indigenous chickens at Rajshahi City Corporation Area

4. Discussion

4.1 Feather type

More than 95% of indigenous chickens of this study showed that the normal feather type have a similarity with the reports of previous workers (Getu *et al.*, 2013 ^[19]; Bhuiyan *et al.*, 2005 ^[11]) whereas Tabassum, *et al.* (2014) ^[36] reported it as 86% and Naked Neck percentage was similar with our findings. In Ghana the naked neck showed a percentage of 5.5 and normal feather was 94.5% (Brown *et al.*, 2017 ^[14]) and in Ethiopia Beckle *et al.* (2022) ^[8] had found that indigenous chicken with normal feather 91.33% and naked neck 8.67% whereas Musa (2022) ^[29] investigated 68.6% indigenous chickens of Ethiopia had normal feathering and 4.3% naked neck. So, we are in agreement with the aforesaid workers except the report of Musa (2022) ^[29].

4.2 Head shape

Plain head shape (51.18%) was found as dominant over crest type (48.82%) in Ethiopia (Halima *et al.*, 2007 ^[20]). The occurrence of plain head of Botswana indigenous chickens showed 56.4% and crest 43.6% (Machete *et al.*, 2021 ^[23]). In Ethiopia 78.1% plain head was dominant over barred 21.9% Musa (2022) ^[29]. In the present study plain head shape was 69.34% followed by 26.42% as cocks comb and 4.24% as crested (Table 1; Graph: 4). These results are similar with the aforesaid reports where they also found plain head shape as the dominant trait.

4.3 Plumage colour

Indigenous chicken have great variations in plumage color. Black brownish 35%, brown with black strip 30%, completely black 30% and golden red 5% (Monira and Hussain, 2018

[27]). Ferdaus *et al.* (2016) [18] reported that the black colour was predominant type with a percentage of 41.11 in indigenous chicken in Bangladesh which was similar (black 21.8%) with Liyanage *et al.* (2015) [22] in Sri Lanka. In a study conducted in Pakistan by Bibi *et al.* (2021) [13] where the different plumage colour showed differences with highest values in different native chicken populations (green 36.8%; red 32%; white 35.6%; multicolour 65.7% in male, 65.50% in female). (Halima *et al.*, 2007 [20]) studied eight different types of plumage colour in Ethiopian indigenous chickens and found 25.49% as white with highest value among all. Apuno *et al.* (2011) [4] described the highest plumage colour was black and mottled (17.07%) in Nigerian indigenous chickens. Plumage colour was found to have significant effect on quantitative characters which has an impact on environment (Apuno *et al.*, 2011 [4]) and the diversity is indicative of many genes governing the traits and random mating (Akhilu *et al.*, 2013 [3]). In this study multi-colour showed highest frequency (25%) followed by golden mixed 19.81%, brownish black 16.51%, white and black 16.04%, black 15.56% and white 7.08%. The present results are not in agreement with the previous reporters mentioned above because of the presence of great variations in plumage colour phenotype.

4.4 Shank colour

The shank colour of native chickens showed variability all over the world. The highest values showed as yellow in all localities individually (33.3%, 46.1%, 24.5%, 30.5%, 40.3%) in Pakistan Bibi *et al.* (2021) [13] which was in agreement with Liyanage *et al.* (2015) [22] in Sri Lanka (yellow 51%), Musa (2022) [29] (47.1% yellow) in Ethiopia, (Halima *et al.*, 2007 [20]) (yellow 64.42%) in another study in Ethiopia. On the other hand, the Nigerian indigenous chickens showed their shank colour as pink with highest value (38.80%) (Apuno *et al.*, 2011 [4]). Botswana indigenous chickens showed grey as dominant (32.9%) followed by blue (24.3%), khaki (24.26%), yellow (11.8%) and green (6.7%) (Machete *et al.*, 2021 [23]). Beckle *et al.* (2022) [8] reported that yellow (85.33%) had highest value among others (grey, 11.6%, red 3%) in Ethiopian indigenous chickens. The 90% of indigenous chicken had white shank and 10% had black shank (Monira and Hussain, 2018 [27]) whereas Ferdaus *et al.* (2016) [18] found black (27.78%) as dominant among others in Bangladesh. Similar results with white dominant characters reported by Moreda *et al.* (2014) [28] in Ethiopia (white 33.73%, yellow 32.48%, brown 11.4% and black 7.75%) was consistent with our findings where white was dominant as 38.21% followed by black 24.53%, yellow 23.58%, and brown 13.68%.

4.5 Comb type

In our present study we found a high proportion (93.87%) single comb and lower proportion of pea (2.36%), rose (2.83%) and very low cushion type (0.94%) which were similarly reported by Bibi *et al.* (2021) [13] (92.5% in Pakistan), Monira and Hussain (2018) [27] (99% single comb and others 1% in Bangladesh), Tabassum, *et al.* (2014) [36] (99% single comb in Bangladesh), Bhuiyan *et al.* (2005) [11] in Bangladesh (97% single comb), Apuno *et al.* (2011) [4] in Nigeria (96.45% single comb and 0.44% pea comb) and Badubi *et al.* (2006) [5] in Botswana (90% single comb and 1% pea comb) whereas Ferdaus *et al.* (2016) [18] reported 100% indigenous chickens had single comb in Bangladesh chickens. Similarly, the comb type of present study showed consistency with the reports of Beckle *et al.* (2022) [8] (Ethiopia: 80.83% single, 16.33% double, 1.67% strawberry

and 1.17 rose), (Machete *et al.*, 2021) [23] (Botswana), Moreda *et al.* (2014) [28] (Ethiopia), Liyanage *et al.* (2015) [22] (Srilanka), Banerjee (2012) [6] (India). But Halima *et al.* (2007) [20] found an exceptional result (single comb 13.34% only) and Musa (2022) [29] (single, 19%; double, 81%) which were not in agreement with other workers and also us. Thus, the results of the present study and published reports from others research works suggested that the single comb is dominant over any comb type.

4.6 Ear lobe colour

The ear lobes colour was 67.6% as red followed by 11.8% black, 11.1% yellow, and 9.6% white (Machete *et al.*, 2021) [23]. In Bangladesh 53.33% indigenous chickens had red color earlobe and the rest had white earlobe (Monira and Hussain, 2018) [27] was similar with the reports (red/reddish dominant over white) of Ferdaus *et al.* (2016) [18] in Bangladesh and Liyanage *et al.* (2015) [22] in Sri Lanka. In Ethiopia 54.17% indigenous chickens were with yellow colour and others were as red (22.33%), white and red 15.33% and white 8.17% Beckle *et al.* (2022) [8] whereas in the same country Ethiopia white and red ear lobe colour was found 49.3% as highest value among others (red 24.3%, white 18.6% and yellow 7.9%) Musa (2022) [29]. The present study advocated that red ear lobe percentage (63.68%) was higher than the white (26.32%) coloured ear lobe indicated that the values of this qualitative character is relevant to aforesaid researchers except Beckle *et al.* (2022) [8].

Naked neck had lower body weight than normal (Tabassum, *et al.*, 2014 [36]; Sarkar, *et al.*, 2014 [34]) and there is a significant effect of plumage colour on back length and body circumference (Apuno *et al.*, 2011 [4]; Shahjahan *et al.*, 2011 [35]) whereas shank and earlobe colour had no effect on body weight, back length, body circumference and pelvis width (Tabassum, *et al.*, 2014 [36]; Apuno *et al.*, 2011 [4]; Bianchi *et al.*, 2007 [12]). Comb type associated with gonadal development (Bell, 2002) [9], body weight and pelvis width (Tabassum, *et al.*, 2014) [36]. Thus, the phenotypical traits (qualitative) showed relations to morphological characters (quantitative) which might keep role in selection program to consumer choice based improvement as well as to restoration of indigenous chicken breeds from their genetic erosion. Base on this work, a project with qualitative and quantitative traits of indigenous chickens will be explored very soon.

5. Conclusion

The phenotypic traits of indigenous chicken were estimated from three different areas of Rajshahi City Corporation Areas at population levels. The resulting percentages showed some phenotypes were dominant by nature and some were profusely diluted. They might be resulting from genic actions or environmental impacts. Also, the phenotypes of indigenous chickens sometimes used as choosing marker to consumer for their tasty meat and nutritious eggs. Thus, the assessment of qualitative phenotypic characters of indigenous chickens might keep impact on the restoration of genetic resources through high valued phenotypic traits' selection and breeding as well as improvisation chickens' as attractive to mass people during purchase.

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Conflict of Interest

Not available

Financial Support

Not available

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