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General and reproductive behaviour of Indian domestic pigeon (*Columba livia*) in relation to haematology

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Abstract

The Importance of the study was to obtain hematological parameters in relation to age, sex and behavioral values in wild-living pigeons. We found the significant differences in the erythrocyte count, hematocrit, hemoglobin concentration and erythrocyte sedimentation rate in relation to age of pigeons. There were no differences in hematological values between males and females. The leukogramand H/L ratio did not vary by age and sex in pigeons. As far as we know, this is the first study in which the morphometric parameters of blood cells in pigeons were presented. We found extremely low concentration of lead in blood (at subtreshold level). No blood parasites were found in blood smears. The analysis of body mass and biometric parameters revealed a significant difference dependent on age and sex. No differences in the scaled mass index were found. Our results represent a normal hematologic and blood chemistry values and age-sex related changes, as reference values for the pigeons. The investigation on "General and reproductive behavior of Indian domestic pigeon in relation to hematology" has been specially aimed to focus on over all behavioral pattern related to reproduction, growth and development of the pigeon with physiological adaptations and variations in corpuscular haematological parameters. Present research has been designed to find out variation corpuscular haematological parameters related to reproduction, growth, development and behavior of the domestic or feral pigeon.

Key words: Hematological parameters, blood parasites, biometric parameters, morphometric parameters, physiological adaptations

Introduction

The science of ornithology has a long history and studies on birds have helped develop several key concepts in evolution, behavior and ecology such as the definition of species, the process of speciation, instinct, learning, ecological niches, guilds, island biogeography, phylogeography and conservation. Most modern biological theories apply across taxonomic groups and the number of professional scientists who identify themselves as "ornithologists" has therefore declined (Bibby, 2003). A wide range of tools and techniques are used in ornithology, both inside the laboratory and out in the field, and innovations are constantly made (Campbell, 2004). Smaller forms are usually called doves, larger forms pigeons. An exception is the white domestic pigeon, the symbol known as the "dove of peace." The role of gene expression in developmental differences and morphological variations has been studied in Darwin's finches. The difference in the expression of Bmp4 have been shown to be associated with changes in the growth and shape of the beak (Abzhanov *et al.*, 2004 & Burnham, 2003). The funnel can have a transparent top and visible cues such as the direction of sunlight may be controlled using mirrors or the positions of the stars simulated in a planetarium (Emlen, & Emlen, 1966).

Difference between Male and Female Pigeons:

• Males are larger and heavier than the females.

• Males coo more, while females peep and squeak more.

•Male pigeons perform an attractive dance following the female, while female watches it and shows her acceptance by simply dropping the wings down before mating.

•Most obviously, females lay eggs, but males do not upon mating.

•Usually, males incubate eggs during the morning session, whereas female takes it over for the rest of the time including afternoon and night.

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Material and Methods

Experimental Laboratory animal

Experiments were done on male and female pigeons at the Department of Zoology, S.K.M. University, Dumka, Jharkhand after ethical approval from the department.

Behavioural Study: Behavioural and reproductive study of male & female squabs and adults was done in the department.

Haematological Assays

Collection of Blood : The blood and tissues from the pigeons have been taken out as a sample to test and collect the data. Blood samples were obtained from the Veins puncture for both haematological assay (blood in EDTA vial).

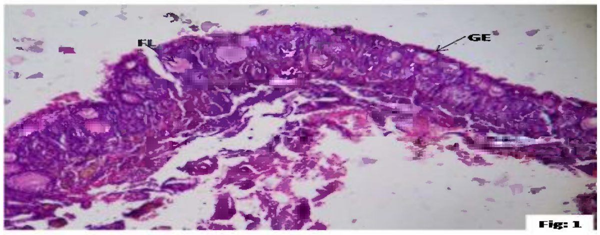
1. Red Blood Cell Count
2. White Blood Cell Count
3. Differential Leucocyte Count
   a. Granulocytes
   b. Monocytes and
   c. Lymphocytes
4. Hemoglobin Concentration
5. Erythrocyte Sedimentation Rate
6. Hematocrit
7. Mean corpuscular volume (MCV)
8. Mean corpuscular hemoglobin (MCH)
9. Mean corpuscular hemoglobin concentration (MCHC)

Haematological Observations:

Total Erythrocyte Count (TEC) of male squab is 4.320 ± 0.04359 million /Cu mm while TEC of male pigeon was 4.860 ± 0.08327 million /Cu mm. TEC of female squab was 4.390 ± 0.04933 million /Cu mm while TEC of female pigeon was 4.590 ± 0.03786 million /Cu mm statistically significant at $p< 0.05$.Haemoglobin of male squab is 11.65 ± 0.1041 gm/dl while haemoglobin of male pigeon was 13.27 ± 0.3712 gm/dl. Haemoglobin of female squab was 11.82 ± 0.04410 gm/dl, while haemoglobin of female pigeon was 12.57 ± 0.1453 gm/dl statistically significant at $p< 0.05$. PCV of male squab is 40.33 ± 1.453 percent while PCV of male pigeon was 44.00 ± 1.732 percent. PCV of female squab was 39.00 ± 0.5774 percent, while PCV of female pigeon was 40.00 ± 1.155 percent statistically significant at $p< 0.05$. ESR of male squab is 18.67 ± 0.8819 mm, while ESR of male pigeon was 10.33 ± 0.8819 mm. ESR of female squab was 14.00 ± 0.5774 mm, while ESR of female pigeon was 19.67 ± 0.8819 mm statistically significant at $p< 0.05$. TLC of male squab is 15967 ± 145.3/Cu mm, while TLC of male pigeon was 12333 ± 145.3 /Cu mm. TLC of female squab was 16033 ± 176.4/ Cu mm, while TLC of female pigeon was 12617 ± 101.4/Cu mm statistically significant at $p< 0.05$. MCH of male squab is 26.63 ± 0.2028 µµgm, while MCH of male pigeon was 28.57 ± 0.1453 µµgm. MCH of female squab was 26.80 ± 0.1732 µµgm, while MCH of female pigeon was 26.67 ± 0.1453 µµgm statistically significant at $p< 0.05$. MCHC of male squab is 29.13 ± 0.3283 gm/dl, while MCHC of male pigeon was 32.17 ± 0.1856 gm/dl. MCHC of female squab was 29.83 ± 0.2603 gm/dl, while MCHC of female pigeon was 30.87 ± 0.4631 gm/dl statistically significant at $p< 0.05$. MCV of male squab is 89.63 ± 0.6360 fl, while MCV of male pigeon was 89.60 ± 0.4726 fl. MCV of female squab was 88.33 ± 0.4807 fl, while MCV of female pigeon was 86.83 ± 1.014 fl statistically significant at $p< 0.05$.

Bleeding time of male squab is 25.67 ± 0.6667 second, while bleeding time of male pigeon was 29.67 ± 0.8819 second. Bleeding time of female squab was 34.33 ± 1.202 second, while bleeding time of female pigeon was 39.67 ± 1.453 second statistically significant at $p< 0.05$. Clotting time of male squab is 191.7 ± 7.265 second, while clotting time of male pigeon was 184.3 ± 8.090 second. Clotting time of female squab was 236.3 ± 4.910 second, while clotting time of female pigeon was 217.7 ± 7.219 second statistically significant at $p< 0.05$. Neutrophil of male squab is 77.67 ± 1.453 percent, while neutrophil of male pigeon was 73.33 ± 1.202 percent. Neutrophil of female squab was 77.33 ± 2.028 percent, while neutrophil of female pigeon was 76.33 ± 1.453 percent statistically significant at $p< 0.05$ (Graph - 11).Lymphocyte of male squab is 20.33 ± 1.453 percent, while lymphocyte of male pigeon was 24.00 ± 1.155 percent. Lymphocyte of female squab was 22.67 ± 1.453 percent, while lymphocyte of female pigeon was 23.00 ± 2.082 percent statistically significant at $p< 0.05$.Eosinophil of male squab is 01 percent, while eosinophil of male pigeon was 01 percent. Eosinophil of female squab was 00 percent, while eosinophil of female pigeon was 00 percent statistically significant at $p< 0.05$.Monocyte of male squab is 01 percent, while monocyte of male

Plate: I



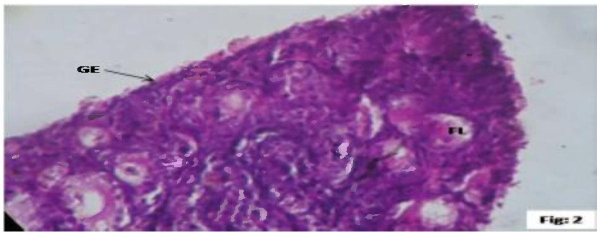
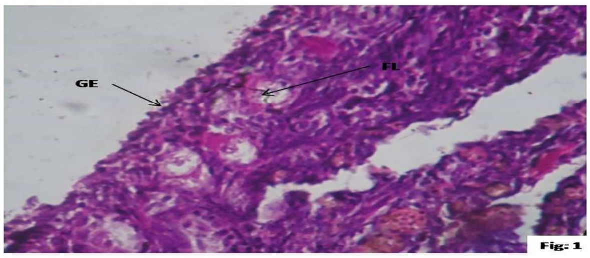


Figure 1: Microphotograph of ovary of female squab stained with eosin and Haemotoxyline show many immature follicles in cortical region of ovary, medulla is not well developed. Germinal epithelium is dense with scattered nuclei.

Figure 2: Microphotograph of ovary of female squab stained with eosin and Haemotoxyline show germinal epithelium with dense and scattered nuclei. Many primary follicles were observed in cortex region of ovary. Immature ova were observed in follicle.

Plate: II



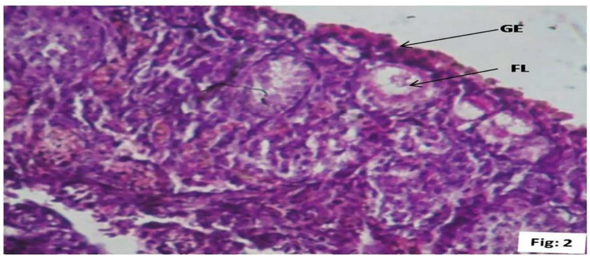
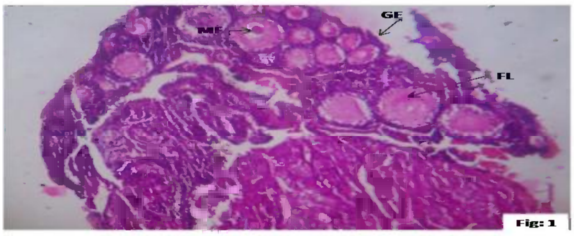


Figure 1: Microphotograph of ovary of female squab stained with eosin and Haemotoxyline show many follicles in immature status. Cytoplasmic material and nuclear material were observed in normal condition. Medulla is not well developed. Germinal epithelium is dense and weavy.

Figure 2: Microphotograph of ovary of female squab stained with eosin and Haemotoxyline show many developing follicules. Many primary follicles were observed in cortex region of ovary. Immature ova were observed in follicle. Germinal epithelium were observed in immature stage.

Plate: III



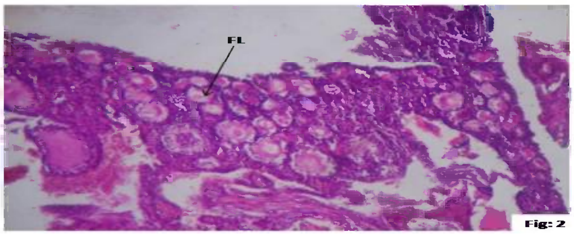
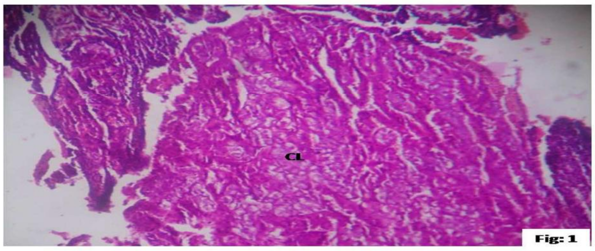


Figure 1: Microphotograph of ovary of adult female Pigeon stained with eosin and Haemotoxyline show mature follicle and many developing follicle with developed and prominent ova. Germinal epithelium is well developed. Corpus luteum was also well developed in structure. Medulla is also well differentiated.

Figure 2: Microphotograph of ovary of adult female Pigeon stained with eosin and Haemotoxyline show many developed primary, secondary and tertiary follicles. Medulla and germinal epithelium is well developed. Different stages of follicle development were observed.

Plate: IV



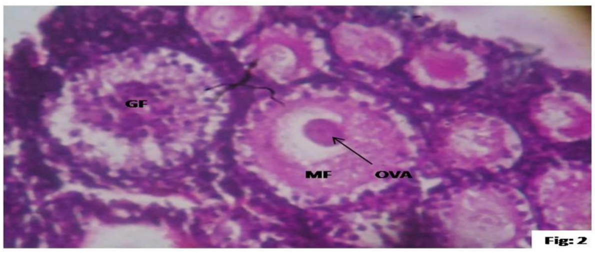


Figure – 1: Microphotograph of ovary of adult female Pigeon stained with eosin and Haemotoxyline show well developed corpus luteum, both cytoplasmic material and nuclear material was normal in structure. Medulla is also well differentiated.

Figure – 2: Microphotograph of ovary of adult female Pigeon stained with eosin and Haemotoxyline show many developed follicles. Germinal epithelium is well developed. Mature ova was prominent in mature graffian follicles.

Plate: V

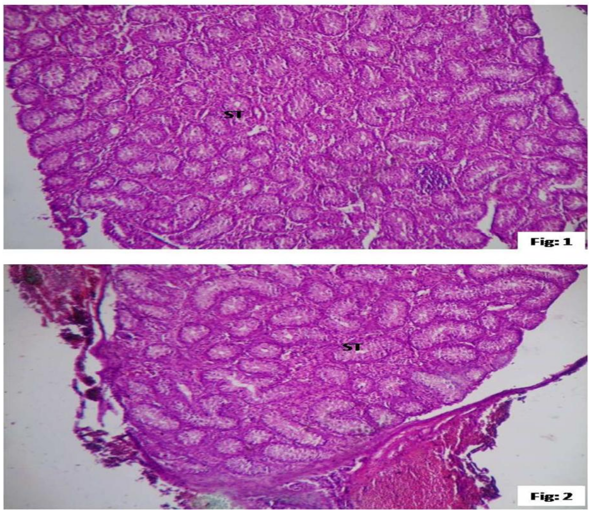


Figure 1: Microphotograph of Testis of Male squab stained with eosin and Haemotoxyline show many immature seminiferous tubule. Immature primary and secondary spermatocyte were observed in seminiferous tubule.

Figure 2: Microphotograph of Testis of Male squab stained with eosin and Haemotoxyline show many developing seminiferous tubule. Many primary spermatocyte were observed in seminiferous tubule. Lumen of seminiferous tubule is not distinct.

Plate: VI

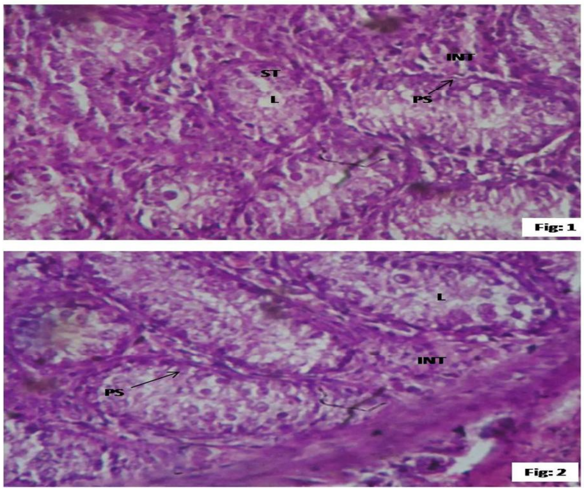


Figure – 1: Microphotograph of Testis of Male squab stained with eosin and Haemotoxyline show many immature spermatocyte. Many immature secondary spermatocyte were observed in seminiferous tubule. Wall of seminiferous tubule is thick.

Figure – 2: Microphotograph of Testis of Male squab stained with eosin and Haemotoxyline show intact seminiferous tubule with ill developed cytoplasm. Interstitial space are filled with cytoplasmic material. Lumen of cytoplasm was not distinct.

Plate: VII

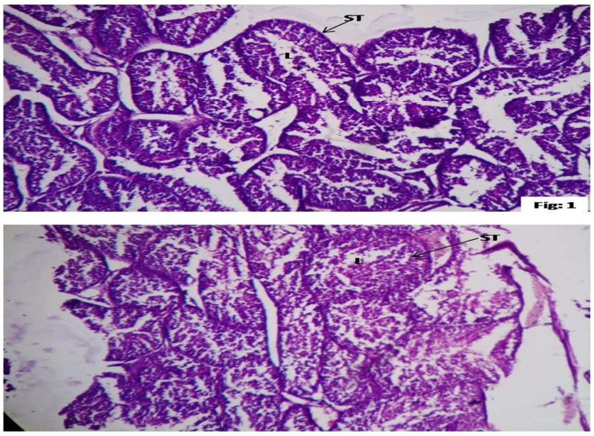


Fig: 2

Figure – 1: Microphotograph of Testis of adult Male pigeon stained with eosin and Haemotoxyline show distinct primary and secondary spermatocyte. Lumen of seminiferous tubule is distinct. Interstitial spaces are well organized.

Figure – 2: Microphotograph of Testis of Male squab stained with eosin and Haemotoxyline show distinct seminiferous tubule. Different stages of spermatogenesis were visible. Spermatid was also visible in lumen.

Plate: VIII

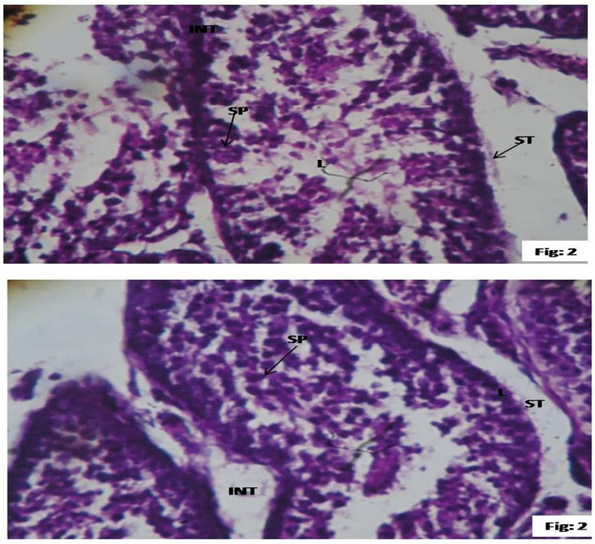


Figure – 1: Microphotograph of Testis of adult Male pigeon stained with eosin and Haemotoxyline show distinct primary and secondary spermatocyte. Lumen of seminiferous tubule is distinct. Interstitial spaces are well organized.

Figure – 2: Microphotograph of Testis of adult Male pigeon stained with eosin and Haemotoxyline show distinct seminiferous tubule with well organized spermatocyte and spermatid. Lumen was distinct.

pigeon was 01 percent. Monocyte of female squab was 00 percent, while monocyte of female pigeon was 00 percent statistically significant at $p< 0.05$.Basophil of male squab is 00 percent, while Basophil of male pigeon was 00 percent. Monocyte of female squab was 00 percent, while monocyte of female pigeon was 00 percent statistically significant at $p< 0.05$.

Results and discussion

Behavioral Studies

1. Flocking behavior of Pigeons : Flying birds often form flocks, with social, navigational and anti-predator implications. Further, flying in a flock can result in aerodynamic benefits, thus reducing power requirements, as demonstrated by a reduction in heart rate and wing beat frequency in pelicans flying in a V-formation. But how general is an aerodynamic power reduction due to group-flight? V-formation flocks are limited to moderately steady flight in relatively large birds, and may represent a special case. What are the aerodynamic consequences of flying in the more usual 'cluster' flock? Here we use data from innovative back-mounted Global Positioning System (GPS) and 6-degrees-of-freedom inertial sensors to show that pigeons .

2. Social Systems in Pigeons : Many city squares are famous for their large pigeon populations, for example, the Piazza San Marco in Venice, and Trafalgar Square in London. For many years, the pigeons in Trafalgar Square were considered a tourist attraction, with street vendors selling packets of seeds for visitors to feed the pigeons. The feeding of the Trafalgar Square pigeons was controversially banned in 2003 by London mayor Ken Livingstone. However, activist groups such as Save the Trafalgar Square Pigeons flouted the ban, feeding the pigeons from an area south of Nelson's Column in which the ban does not apply.

3. Feeding Behavior : Domestic Pigeons mainly eats seeds and grains. Pigeons also eat insects, fruit, and vegetation, and scavenge food people provide for them intentionally or unintentionally. Pigeons feed on open ground such as that found in parks and squares, on rooftops.

4. Parental Care : Baby pigeons, normally called squabs, require about 24 hours to peck and wiggle their way out of their egg. Those who raise baby pigeons need to allow the little squab to work their own way out of the egg, as the fight for freedom is a healthy part of their body's development and any interference can cost them their life. Once their damp downy little bodies emerge, the baby pigeon is considered to be one of the least attractive of baby birds, with large awkward eyes and almost thin floppy neck. Of course, as they grow up they will adapt a more visually appealing body.

Histopathological Study: Histological study of Testicular & Ovarian tissues of Squab & adult pigeons was done. Available information indicates that haematological values of avian species are also significantly influenced by poultry diseases including fowl typhoid (Kokosharov and Todorova, 1987), mycoplasmosis (Branton *et al.,* 1997; Burnham *et al.,* 2003). Since the white blood cells in the avian species, in general, serve to phagocytic function similar to their mammalian counterparts (Campbell, 1988) and differential leukocyte count as well as H / L ratio were used as indicators of stress response.

Histology of ovary of female squab: Ovary of female squab show many immature follicles in cortical region of ovary, medulla is not well developed. Germinal epithelium is dense with scattered nuclei (Plate–I, Fig:1). Ovary of female squab show germinal epithelium with dense and scattered nuclei. Many primary follicles were observed in cortex region of ovary. Immature ova were observed in follicle (Plate– I, Fig: 2). Ovary of female squab show many follicles in immature status. Cytoplasmic material and nuclear material were observed in normal condition. Medulla is not well developed. Germinal epithelium is dense and wavy (Plate–II, Fig:1). Ovary of female squab show many developing follicles. Many primary follicles were observed in cortex region of ovary. Immature ova were observed in follicle. Germinal epithelium were observed in immature stage (Plate– II, Fig: 2).

Histology of ovary of adult female pigeon: Ovary of adult female Pigeon show mature follicle and many developing follicle with developed and prominent ova. Germinal epithelium is well developed. Corpus luteum was also well developed in structure. Medulla is also well differentiated (Plate – III, Fig: 1). Ovary of adult female Pigeon show many developed primary, secondary and tertiary follicles. Medulla and germinal epithelium is well developed. Different stages of follicle development were observed (Plate – III, Fig: 2). Ovary of adult female Pigeon show well developed corpus leuteum, both cytoplasmic material and nuclear material was normal in structure. Medulla is also well differentiated (Plate– IV, Fig: 1). Ovary of adult female Pigeon show many developed follicles. Germinal epithelium is well developed. Mature ova were prominent in mature graffian follicles (Plate–IV, Fig: 2).

Histology of testis of male squab: Testis of male squab show many immature seminiferous tubules. Immature primary and secondary spermatocyte were observed in seminiferous tubule (Plate–V, Fig:1). Testis of Male squab show many developing seminiferous tubule. Many primary spermatocyte were observed in seminiferous tubule. Lumen of seminiferous tubule is not distinct (Plate–V, Fig: 2). Testis of Male squab show many immature spermatocyte. Many immature secondary spermatocyte were observed in seminiferous tubule. Wall of seminiferous tubule is thick (Plate–VI, Fig:1). Testis of Male squab show intact seminiferous tubule with ill developed cytoplasm. Interstitial spaces are filled with cytoplasmic material. Lumen of cytoplasm was not distinct (Plate–VI, Fig: 2).

Histology of testis of adult male pigeon: Testis of adult male pigeon show distinct primary and secondary spermatocyte. Lumen of seminiferous tubule is distinct. Interstitial spaces are well organized (Plate – VII, Fig: 1). Testis of male squab show distinct seminiferous tubule. Different stages of spermatogenesis were visible. Spermatid was also visible in lumen (Plate–VII, Fig: 2). Testis of adult male pigeon show distinct primary and secondary spermatocyte. Lumen of seminiferous tubule is distinct. Interstitial spaces are well organized (Plate–VIII, Fig: 1). Testis of adult male pigeon show distinct seminiferous tubule with well organized spermatocyte and spermatid. Lumen was distinct (Plate–VIII, Fig: 2). The investigation on "General and reproductive behaviour of Indian domestic pigeon in relation to hematology" has been specially aimed to focus on over all behavioral pattern related to reproduction, growth and development of the pigeon with physiological adaptations and variations in corpuscular haematological parameters.Present research has been designed to find out variation corpuscular haematological parameters related to reproduction, growth, development and behaviour of the domestic or feral pigeon.The Rock Dove (Columba livia) or Rock Pigeon is a member of the bird family Columbidae (doves and pigeons). In common usage, this bird is often simply referred to as the "pigeon".The domestic pigeon (*Columba livia*) (also called the rock dove or city pigeon) was originally found in Europe, Northern Africa, and India. Early settlers introduced it into the eastern United States as a domestic bird in the 1600s. Since then, it has expanded throughout the United States to Alaska, across southern Canada, and south into South America. Pigeons originally lived in high places-cliffs, ledges, and caves near the sea-that provided them with safety. Over time they have adapted to roosting and nesting on windowsills, roofs, eaves, steeples, and other man-made structures. Feral pigeons (Columba livia), also called city doves, city pigeons, or street pigeons, are derived from domestic pigeons that have returned to the wild. The domestic pigeon was originally bred from the wild Rock Dove, which naturally inhabits sea-cliffs and mountains. Rock (i.e., 'wild'), domestic, and feral pigeons are all the same species and will readily interbreed. Feral pigeons find the ledges of buildings to be a substitute for sea cliffs, have become adapted to urban life, and are abundant in towns and cities throughout much of the world.

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