HAEMATOLOGICAL ASSESSMENT IN GUINEA PIGS (*Cavia porcellus*)

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Abstract:

Guinea pigs are social companion animals that requires daily interaction. They communicate by making various sounds, jump in the air, when happy. Guinea pigs acclimate well to average household temperature, not to exceed 80^0F. These animals is easy to handle; prefers a routines and similar time for playing, feeding and resting. In western society the domestic guinea pig has enjoyed widespread popularity as a household pet, a type of pocket pet. This haematological study determine the whether sex had a significant effect on the haematological analytes in adult guinea pig (*Cavia porcellus*) maintained under normal laboratory conditions. Data analysis revealed several significant difference in haematological parameters between male and female guinea pig. The blood samples was collected from the guinea pigs of different sex and analysed for pack cell volume (PCV), red blood cells (RBC), white blood cells (WBC), Haemoglobin (Hb) concentrations, mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were determined by calculating their absolute values from the analysed blood parameters. The red blood cell count of male guinea pig is 5.2 ± 0.46 million/mm^3 which is higher than female and the value is 4.6 ± 0.47 million/mm^3 and it shows insignificant difference ($p>0.05$) Haemoglobin concentration of male guinea pig is 14.1 ± 1.15g/dl which is higher than female and the value is 13.42 ± 1.22g/dl and it shows significant difference ($p < 0.05$) .The mean corpuscular volume (MCV) of female guinea pig is 98.44 ± 9.92fl which is higher than male and the value is 81.64 ± 5.36fl it shows insignificant difference ($p > 0.05$). Other haematological parameters shows significant difference ($p < 0.05$) which are pack cell volume (PCV), mean corpuscular haemoglobin concentration (MCHC).The sex of adult guinea pig is a source of variation that must be considered in terms of clinical and research data. The data presented here likely will prove useful in the veterinary medical management of guinea pig colonies and provide base line haematological information for researchers wishing to use this species.

Index Terms: Haematology, Health, Sex, *Cavia porcellus.*

I.INTRODUCTION

Blood in demand so precious that is also called "red gold" because the cells and proteins it contains can be sold for more than the cost of the same weight in gold. Blood cell formation are called Haematopoiesis; continuous process through which the cellular constituents of blood are replenished as needed. All cellular

blood components are derived from haematopoietic stem cells. It also delivers immune cells to fight infections and contains platelets that can form a plug in damaged blood vessel to prevent blood loss. The haematological parameters are influenced through various factors like age, diet, ethnicity, genetic and gender differences.

Guinea pig or domestic guinea pig (*cavia porcellus*) also known as cavy or domestic cavy is a species of rodent. These animals are not in the pig family suidae. They come from Guinea in Africa and origin of their name is still unclear. They originated in the Andes of South America and its lifespan is 4-8 years, scientific name *cavia porecellus* being Latin for 'little pig'. Cavia is New Latin (Morales ,1995). It is use as captive animals as a source of meat. They are used as animal models for the study of disease conditions such as respiratory anaphylaxis, genital herpes, delayed-type hypersensitivity reaction, and scurvy. It also use in hearing research, in case of human disease diagnosis (e.g., tuberculosis legionnaires disease).The guinea pig is commonly used in biomedical research for purposes such as a source of polyclonal antibodies, red blood cells complement and tissues such as kidney. Guinea pigs have been used in a multitude of research roles including physiological, biochemical and pharmacological tests (e.g., assay for the presence of histamine). The guinea pigs suffers from more blood related disorders like anemia, which is represented by a low red blood cell count or haematocrit that falls below the reference range for a given species. Hemolytic anemia could be blood parasites, these are rarely seen in pet rodents. Chronic blood loss could also related to heavy lice infestations sometime observed in rats or guinea pigs. Lymphosarcoma is another blood related disorder .It is the common type of neoplasia affecting guinea pigs and can be caused by a retrovirus. Diagnosis is based on the results of CBC count and cytologic examination. Leukemic guinea pigs show leucocytosis with counts of 25 to 500 X 10 cells/mm (Cohen and Rifkind, 2002).

The analysis of blood parameters is highly required in order to detect blood related diseases at an earlier stage. Since the reference ranges of haematological parameters are inadequate and inconsistent. So the aim of this study is to analyse the haematological parameters of both male and female guinea pig.

II. MATERIALS AND METHOD

STUDY AREA

The study was conducted at Centurion University of technology and management, Bhubaneswar campus. The campus is geographically situated in 23 km from the Bhubaneswar. This campus is fulfilled much more fauna. It is situated near Barunai hill near Jatni town, Khordha district.The latitude and longitude of the campus are 20.1756^0 North and 85.7066^0 East respectively.

II.2 BLOOD SAMPLING

Several veins are used as common venepuncture sites in guinea pigs, including the metatarsal veins of the hind limbs, lateral saphenous and cephalic veins of the forelegs. Additional methods include the jugular vein, femoral vein, cranial vena cava, pricking a tiny vein in the pinna or close clipping of a nail.

Blood collection may be accomplished using a needle and syringe, With a needle and syringe method, a needle of 23 to 25 gauge on a 1.0ml syringe is inserted in the vain in a distal to proximal direction and with slow aspiration to avoid collapse of the vessel, about 1 to 1.5ml of blood was collected(Dacie and Lewis,2017) .After collection of blood, it was transferred into anticoagulant Ethelenediaminetetraacetic acid (EDTA) vial for analysis of haematological parameters like haemoglobin, RBC, PCV,MCV,MCH,MCHC,WBC and DLC.

Haemoglobin concentration (Hb) was measured by sahli's acid haematin method by using N/10 HCL, blood sample, distil water.The Red blood cell count (RBC) and white blood cell count (WBC) were estimated by diluting the blood with Hayem's and Turks fluid respectively and then counted by using Neubauer's chamber. Packed cell volume (PCV) was determined by microhaematocrit method .

Erythrocyte indices like mean corpuscular volume (MCV),mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated as per following formula.

MCV= (PCV/RBC) x10

MCH= (Hb /RBC) x10

MCHC= (Hb /PCV) X100

For differential leucocyte count (DLC) blood smears were prepared at the site of blood collection in order to prevent morphological changes of blood cells .The smeared slides were fixed with methanol and stained by using Giemsa stain.

RESULTS AND DISCUSSION

Haematology is the study of blood and the disorder related to it. Blood has many function including regulating body temperature, transporting oxygen, and supporting the immune system. Number of factors affecting the haematological values in healthy individuals. Specimens are collected at the same time of the day. Preferably in the morning before 9 AM (Dacie, 2017). Haematological parameters includes haemoglobin,RBC,PCV,MCV,MCH,MCHC,WBC and DLC (Table 1).

HAEMOGLOBIN (Hb)

In guinea pig the mean ±SE of haemoglobin is found to be greater in male 14.1 ± 1.15g/dl than the female 13.42 ± 1.22g/dl (Fig.1). Here Hb count differ significantly with respect to sex at ($p<0.05$) level.

The deleterious effects of iron deficiency and iron deficient anaemia are due to impaired delivery of oxygen to the tissue. (Hallberg et al., 1966).Reduced thermoregulation has also been confirmed in case of mammals, who are iron deficient where norepinephrine concentrations was increased, and differences were found in concentrations of epinephrine, dopamine, triiodothyronine and thyroxine.

RED BLOOD CELLS(RBC)

The mean ± SE of RBC is greater in male 5.2 ±0.46 million/mm^3 than in female 4.6 ±0.47 million/mm^3 guinea pig and the difference is statically insignificant. (p=0.181524); (p >0.05) (Fig.2).

Testosterone is the hormone which directly stimulates erythropoietin hormone. As a result more RBC production in case of male (5.2±0.46) than female. Females tend to have more granulocytes and a proportionately larger lymphomyeloid complex (bone marrow, spleen, thymus, lymph nodes and lymphoepithelial tissues) and greater immunological competence than males (Glucksmann, 1974).At high stress level and more exposure to time, which causes high rate of haemolysis.

III.3 PACK CELL VOLUME (PCV)

PCV is a measurement of the proportion of red blood cells. The value is expressed as percentage or fraction of cells in blood.

In guinea pig the mean ± SE greater in female 43.48 ±1.64% than male 41.5 ±1.48% (Fig.3). In the current study PCV count differs significantly in between male and female (p = 0.034163312) (p < 0.05).

A decreased PCV generally means red blood cell loss from any variety of reasons like cell destruction, blood loss and failure of bone marrow production. An increased PCV generally means dehydration or an abnormal increase in red blood cell production. PCV is the volume of red blood cells in the body. A PCV test measures the ratio of RBC in blood.

During pregnancy the total volume of circulating blood increases (Miller et al., 1915). Red blood cell mass was reported to increase by about 20-30% above nonpregnant levels by the end of pregnancy, which causes increase in erythropoietin production. Therefor increase in plasma volume is more than the increase in red blood cells. Consequently the pack cell volume decreases due to hemodilution (Purohit et al., 2015; Abass et al., 2016).

III.4 MEAN CORPUSCULAR VOLUME (MCV)

MCV is calculated, pack cell volume is devided by red blood cell and multiplied by ten. In guinea pig mean ±SE is greater in female 98.44 ± 9.92fl than male 81.64 ±5.36fl (Fig.4). Here MCV count is insignificant (p= 0.086412) (p > 0.05).

MCV is the average volume of red cells. MCV is elevated or decresed in accordance with average red cell size. The MCV level will be lower in microcytic anaemia; which is caused by iron deficiency, gastrointestinal bleeding.

In case of dehydration fluid volume in blood is less, at that case oxygen carrying capacity of the blood is high in that case mean corpuscular volume is high. Vitamin B12 deficiency and folate deficiencies are also called megaloblastic anemia, due to the macrocytic RBC (Boron,2016).

III.5 MEAN CORPUSCULAR HAEMOGLOBIN (MCH)

In guinea pig mean ±SE is greater in female 29.73 ± 2.49 pg than male 27.38 ± 1.64 pg here MCH count is insignificant (p=0.240412) (p > 0.05). MCH is the average mass of haemoglobin per red blood cell in a sample of blood (Fig.5). High MCH scores are commonly a sign of macrocytic anemia (enough vitamin B 12 or folic acid in the body.

Low MCH level in microcytic anaemia, in this case blood cells are too low due to malnutrition or nutritional deficiencies.

The MCH value directly parallels to the MCV value, if the size of the red blood cells is large the amount of haemoglobin per red blood cells will be high and vice versa.

MEAN CORPUSCULAR HAEMOGLOBIN CONCENTRATION (MCHC)

The measure of the average concentration of haemoglobin inside a single red blood cell. Low MCHC level in case of thalassemia and hypochromic microcytic anaemia, decreased level of haemoglobin (hemolysis) commonly results low MCHC. Autoimmune haemolytic anemia is a condition in which body immune system attacks its own red blood cells; which result of high MCHC develops on its own. The liver stores and processes haemoglobin. In mammals if liver disorder is detected, at that case liver damaging the red blood cells, which may have causes high MCHC. In guinea pig mean ± SE is greater in male 34.00 ±2.54 g/l than female 30.83 ± 2.53g/l. Here MCHC count is significant (p=0.008204) (p < 0.05) (Fig.6).

WHITE BLOOD CELLS (WBC)

In guinea pigs mean ± SE of WBC is greater in male 10.66 ± 2.28 thousands/mm^3 than female 10 ± 1.78 thousands/mm^3. Here white blood cell count is insignificant (0.192939) (p< 0.05) (Fig.7).The result found for WBC is within normal range. The value deviates in disease, stress and reproductive periods.

III.8 DIFFERENTIAL LEUKOCYTE COUNT (DLC)

The blood differential test measures the percentage of each type of white blood cell (WBC).It also reveals the presence of abnormal and immature white blood cells in blood.

The neutrophils in has nuclei that are segmented into lobes of condensed chromatin connected by filaments. Neutrophils are part of the innate immune system and are the first line of defence. In guinea pigs the percentage of neutrophil is greater in male 36.4 ± 2.31% than the female 25.58±2.79% and differed significantly at p<0.05 (Fig.8).

Eosinophil granules are specialised white blood cells that help to fight parasitic infections. In guinea pigs mean ± SE greater in male 5.6 ± 0.50% than female 4.8 ± 0.86%. Here eosinophils count difference is insignificant (0.18695) (p>0.05) with respect to sex (Fig.9). The eosinophil levels increased again with recurrence of cancer (Jin,2015).

The percentage of lymphocytes is the second highest white blood cell after neutrophil. In guinea pigs mean ± SE greater in female 67.4 ± 3.03% than male 53.2 ± 1.74%. Here lymphocyte count is significant

(p=0.014833) (p<0.05) (Fig.10). Lymphocytes are the main cells in lymph nodes. Lymphocytes are special because they can become 'memory cells' and it acts like a foreign invader.

The nucleus of the monocyte is usually kidney – shaped and has brain-like convolutions. In guinea pigs mean ± SE is greater in male 3.82 ± 0.62% than female 2.04 ± 0.34%. Here monocyte count is significant (0.034567) (p<0.05) (Fig.11). Monocytes serve as part of the defence against infection by 'eating' up foreign particles .

Basophils of guinea pigs are filled with small, round, dark purple granules. In guinea pig mean ± SE of percentage of basophils are greater in male 0.98 ± 0.27% than female 0.18 ± 0.09% and difference is statistically significant at p < 0.05) (Fig.12). A low basophil level is called basopenia. It can be caused by infections, severe allergies.

An abnormally high basophil level is called basophilia. It can be a sign of chronic inflammation in mammals also mean that a condition is causing too many white blood cells to be produced in bone marrow.

CONCLUSION

This study presents information on comparative haematology of male and female guinea pig (*Cavia porcellus*). It serve as a means to evaluate the physiological conditions and health status of domesticated guinea pig. Haematological parameters in guinea pig represent a base line value, which provide better understanding of domesticated guinea pig (*Cavia porcellus*). Hematologic values for common laboratory animals can vary widely depending on strain, age and even fasting state. Hematologic profile of guinea pigs could be undertaken by investigating age or environmental factors that could produce statistically significant differences.

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Table1 Haematological parameters of guinea pig

Figures in parentheses represents number of observation.*Significant at $p<0.05$,**significant at $p<0.1$ and *** significant at $p<0.001$ and NS is not significant

HAEMATOLOGICAL PARAMETER	UNIT	MALE (10)	RANGE	FEMALE (10)	RANGE	P.VALUE
Hb	g/dl	14.1	11-17	13.42	10.3-16.2	0.006492**
RBC	Millions/mm^3	5.2	4 - 6.5	4.6	3.35 – 6.15	0.181524NS
PCV	%	41.5	37-46	43.48	40.9-49.9	0.034163312*
MCV	fl	81.64	63.07-92	98.44	67.47-122.08	0.086412NS
MCH	pg	27.38	22-31.11	29.73	22.11-35.55	0.240412NS
MCHC	%	34.00	25.58-41.46	30.83	23.89-38.57	0.008204**
WBC	Thousands/mm^3	10.66	5.5-17.5	10	5-15	0.192939NS
NEUTROPHILS	%	36.4	30-42	25.58	20-34.3	0.029422*
EOSINOPHILS	%	5.6	4-7	4.8	2-7	0.18695NS
LYMPHOCYTES	%	53.2	48-58	67.4	56.7-75	0.014833**
MONOCYTES	%	3.82	2.3-6	2.04	1-3	0.034567*
BASOPHILS	%	0.98	0-1.7	0.18	0-0.5	0.01585**

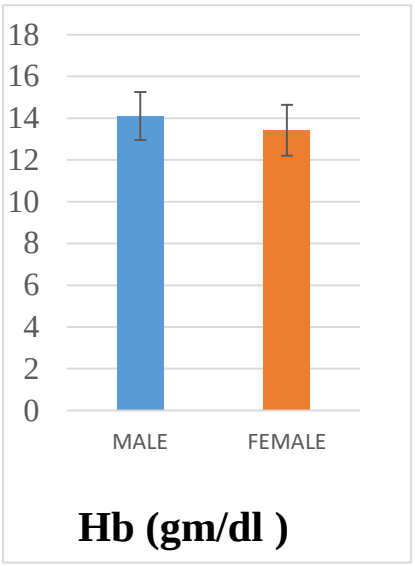

Fig.1 Haemoglobin concentration of male and female guinea pig.

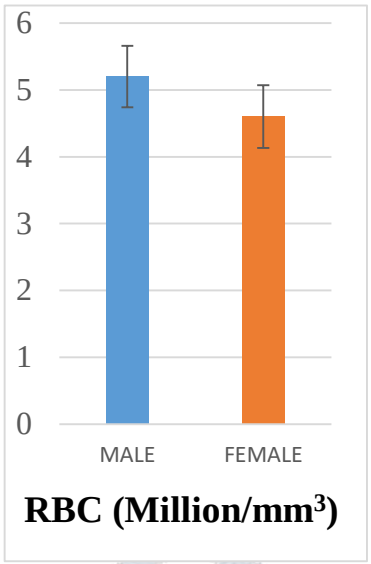

Fig.2 RBC of male and female guinea pig.

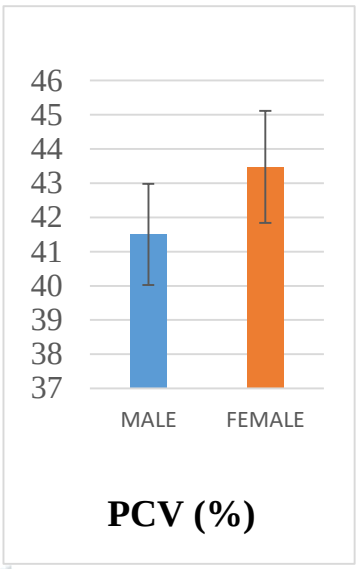

Fig.3 PCV of male and female guinea pig.

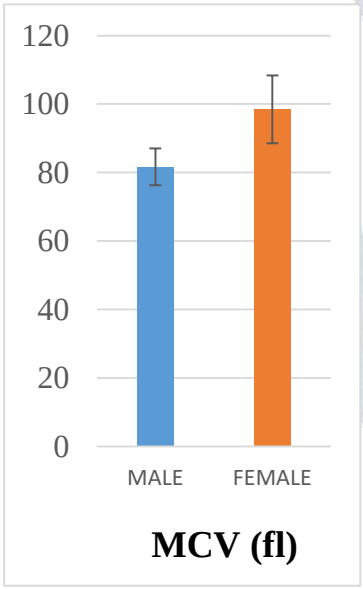

Fig.4 MCV of male and female guinea pig.

Fig.5 MCH of male and female guinea pig.

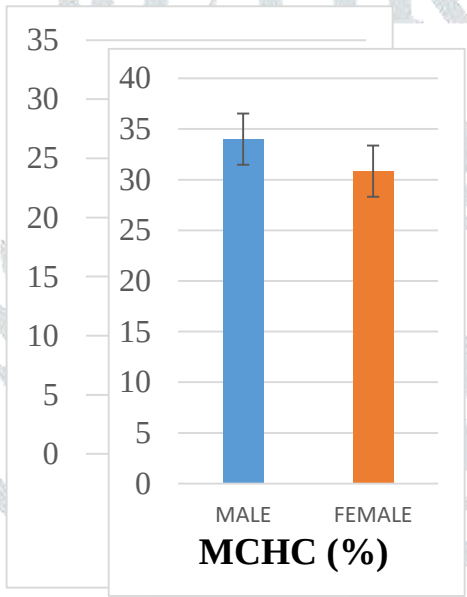

Fig.6 MCHC of male and female guinea pig.

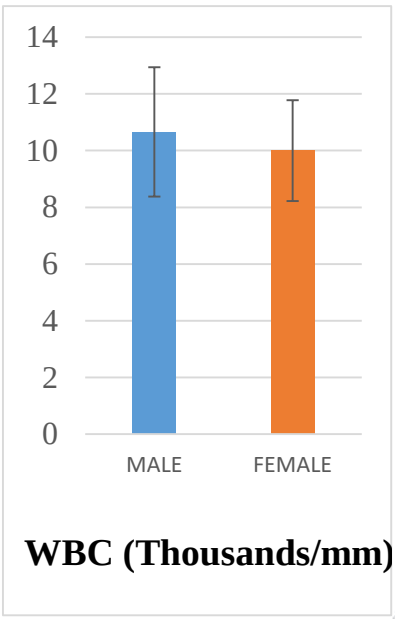

Fig.7 WBC of male and female guinea pig.

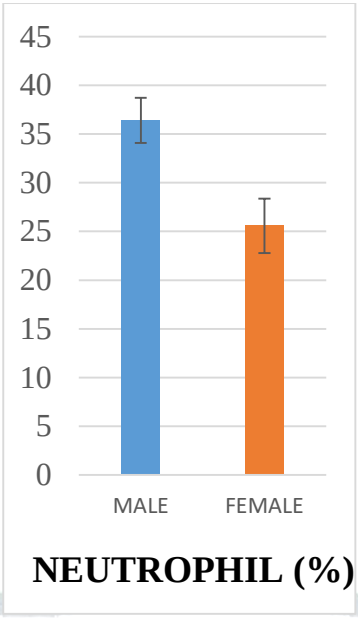

Fig.8 Neutrophils of male and female guinea pig.

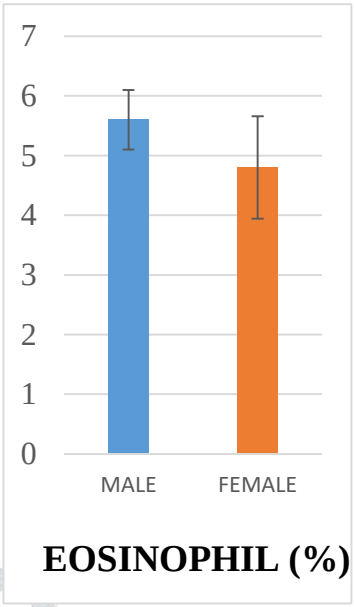

Fig.9 Eosinophils of male and female guinea pig.

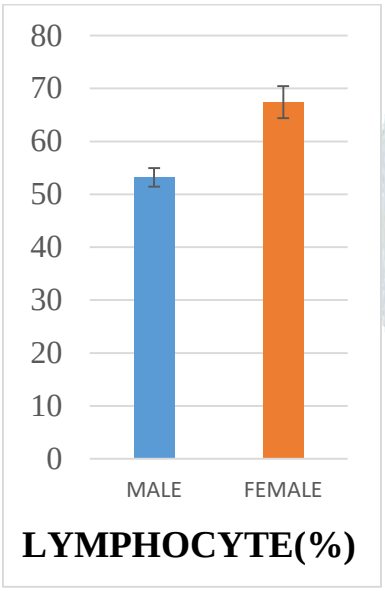

Fig.10 Lymphocytes of male and female guinea pig.

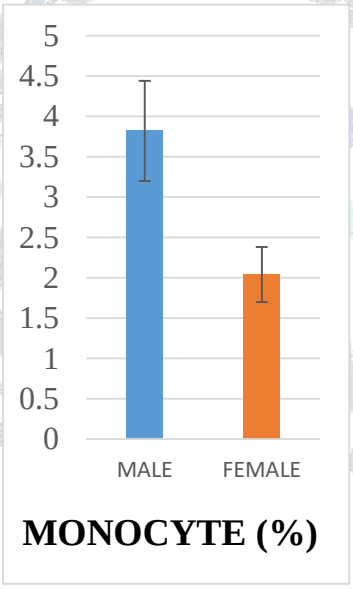

Fig.11 Monocytes of male and female guinea pig.

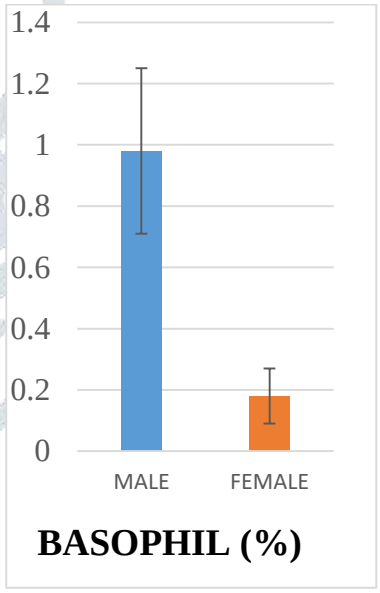

Fig.12 Basophils of male and female guinea pig.