

Hematological Reference Intervals in Miranda's Donkey

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The Miranda's donkey is a Portuguese breed from northern Portugal considered endangered. Several researches in different scientific areas have been conducted to help in these animals preservation. The knowledge of hematological reference intervals is important to characterize the breed, identify the health status of the animals and help veterinarians in the diagnosis of diseases and follow-up of patients. This study aimed to determine the hematological reference intervals for healthy Miranda's donkeys and to evaluate the interference of sex and age in these parameters. Only age interfered in the hematological values and should be considered when interpreting the results. The results described here can be used to assess the health of animals and herds, guide the diagnosis of diseases and assist in the selection of healthy animals for reproduction, contributing to the preservation of the breed.

Hematology

Miranda's donkey

ProCyte Dx

Reference intervals

1. Introduction

The Miranda's donkey is an autochthonous Portuguese breed from northern Portugal. It is currently classified by the Food and Agriculture Organization of the United Nations^[1] as endangered due to its small number of animals. According to the latest survey, released in 2023, the current number of sexually mature Miranda's donkey consists of 726 animals, 652 females and 109 males^[2]. The need to preserve this breed is linked to the conservation of its valuable genetic heritage together with the cultural, historic and economical relevance, especially for family farming in the Planalto Mirandês region. Currently, after government incentives and organizations for the defense of the breed, despite their continuous valuable contribution for agricultural activities, donkeys are also used in therapeutic activities, leisure events, ecotourism, as companion, in the production of milk for human consumption, in the manufacture of cosmetics, control of vegetation and landscape maintenance^[3].

The first steps of preservation procedures for a given breed consist in studying its geographic distribution, number of animals together with its phenotypic and genotypic characteristics^{[4][5][6]}. In addition, hematology studies that allow the identification of reference intervals (RI) for hematological variables are important to characterize a breed and have been used by scientists as a measure to potentiate the conservation of other autochthonous European breeds^{[7][8][9][10][11]}. The RI allows to evaluate the health status of the animals, herds, monitor the evolution of diseases and the response to therapy^[12].

For a long time, veterinarians used hematological RI for horses as a guide for donkeys' healthy status evaluation, which is not adequate, as there are considerable differences between both species [13][14]. Research on the hematological profile of other donkeys' breeds showed that there are differences not only with horses, but also differences between different donkey breeds which demonstrates the relevance of studying this subject in each autochthonous breed [7][8][15]. Moreover, it is also relevant to study the impact of sex and age as they can also influence blood parameters within the same population [16].

Researches in several areas of veterinary medicine were conducted on Miranda's donkey, but to the authors' knowledge, there are no hematology studies. Determining a normal range for hematological parameters in an endangered population such as Miranda's donkey can be difficult due to the limited number of existing animals, but it is essential. However, this study presents the hematological RI (Table 1) for the Miranda's donkey breed and describes the influence of sex and age factors on these intervals.

Table 1. Miranda's donkey hematological reference intervals.

Parameters/Units	RI
RBC (M/ μ L)	4.0-6.8
HCT (%)	24.5-38.4
HB (g/dL)	8.5-13.3
MCV (fL)	50.2-66.5
MCH (pg)	17.5-23.0
MCHC(g/dL)	32.5-36.4
RDW (%)	19.4-25.4
WBC (K/ μ L)	5.0-12.2
NEU (%)	31.9-59.4

LYM (%)	28.2-55.0
MONO (%)	4.2-7.4
EOS (%)	2.7-15.6
BASO (%)	0.0-1.6
NEU (K/μL)	2.0-6.9
LYM (K/μL)	1.7-5.7
MONO (K/μL)	0.2-0.8
EOS (K/μL)	0.3-1.3
BASO (K/μL)	0.0-0.1
PLT (K/μL)	93.8-341.3
MPV (fL)	5.3-7.6
PDW (%)	5.8-8.7
PCT (%)	0.0-0.2

RBC: Red blood cell, **HCT:** hematocrit, **HB:** hemoglobin concentration, **MCV:** mean corpuscular volume, **MCH:** mean corpuscular hemoglobin, **MCHC:** mean corpuscular hemoglobin concentration, **RDW:** red cell distribution width, **WBC:** white blood cell, **NEU:** neutrophils, **LYM:** lymphocytes, **MONO:** monocytes, **EOS:** eosinophils, **BASO:** basophils, **PLT:** platelets, **MPV:** mean platelet volume, **PDW:** platelets distribution width, **PCT:** plateletcrit, **SD:**

Standard deviation, **Min:** Minimum, **Max:** Maximum, **RI:** Reference intervals, **LRL:** lower reference limit, **URL:** upper reference limit, **CI:** Confidence interval.

Sex doesn't influence any of the analyzed parameters. Considering the age, differences are found for RBC, RDW, WBC, LYM (%), LYM, MONO, PLT, PCT (higher average in young), and VCM, MCH, NEU (%), EOS (%) and EOS (higher mean in adults) (Table 2).

Table 2. Hematological reference intervals for young's/adult Miranda's donkey

Parameters/Units	RI (young's)	RI (Adults)
RBC (M/ μ L)	4.1-7.3	3.9-6.6
HCT (%)	24.0-41.1	24.3-39.6
HB (g/dL)	8.2-14.0	8.4-13.2
MCV (fL)	48.8-59.2	52.7-66.2
MCH (pg)	17.3-20.2	18.6-22.9
MCHC(g/dL)	33.1-36.7	32.3-36.4
RDW (%)	19.1-25.9	19.4-25.3
WBC (K/ μ L)	5.4-12.7	4.9-12.8
NEU (%)	30.2-48.7	33.8-63.3
LYM (%)	38.2-56.4	26.6-54.5

MONO (%)	4.4-8.8	4.1-8.1
EOS (%)	1.9-10.7	3.3-16.1
BASO (%)	*	0.0-1.4
NEU (K/μL)	1.5-5.6	1.9-7.4
LYM (K/μL)	3.0-6.5	1.7-5.5
MONO (K/μL)	1.6-5.1	0.2-0.8
EOS (K/μL)	0.1-0.8	0.3-1.4
BASO (K/μL)	0.0-0.2	0.0-0.1
PLT (K/μL)	144.2-350.4	82.8-308.4
MPV (fL)	5.1-7.2	5.3-7.8
PDW (%)	5.8-8.7	5.9-8.7
PCT (%)	0.1-0.2	0.0-0.1

RBC: Red blood cell, **HCT:** hematocrit, **HB:** hemoglobin concentration, **MCV:** mean corpuscular volume, **MCH:** mean corpuscular hemoglobin, **MCHC:** mean corpuscular hemoglobin concentration, **RDW:** red cell distribution width, **WBC:** white blood cell, **NEU:** neutrophils, **LYM:** lymphocytes, **MONO:** monocytes, **EOS:** eosinophils, **BASO:** basophils, **PLT:** platelets, **MPV:** mean platelet volume, **PDW:** platelets distribution width, **PCT:** plateletcrit, **SD:** Standard deviation, **Min:** Minimum, **Max:** Maximum, **RI:** Reference intervals, **LRL:** lower reference limit, **URL:** upper reference limit, **CI:** Confidence interval, *: non computable

The Miranda's donkey constitutes a Portuguese genetic heritage that must be protected, and efforts are still needed to increase the number of individuals, especially those of reproductive and fertile age, in order to avoid the extinction of the breed. The RI described here can be used to assess and monitor the health status of animals and herds, as well as guide the diagnosis, or select fit and healthy animals for reproduction, contributing to the preservation of the breed. It is important to emphasize that age can influence the hematological results, therefore, must be considered by professionals when interpreting the tests.

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