

RELATIONSHIPS AMONG PERFORMANCE, SEX AND ERYTHROGRAM IN THOROUGHBRED HORSES *

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Various factors of physiologic and ecologic order have been studied regarding their influence over the blood picture of the equines and many works have showed that alterations of the latter may be the status of health or, on the other hand, may influence the physical capacity. In spite of these correlations, few investigators were interested in the analysis of the relations between hemogram and the capacity of the animal.

Patrushev (9) seemed to be the first one to verify that the quickest horses had higher concentrations of erythrocytes. Later on, there appeared the works of Brenon (2), Irvine (6) and Steel & Whitlock (14), who attempted to demonstrate that the good racers have a better blood picture. Regarding to the influence of sex over the results of the hematologic tests there are great controversies in the literature. Van Den Berg (16) did not verify significant differences in the hemoglobin value and Vaulont (17) noted them for the erythrocytes. McLeod et al. (8), who analysed the blood picture of the Thoroughbred Horses and of the Arabian Horses under different conditions, established that stallions have the highest value for the erythrocytes while the barren mares the lowest. Hansen et al. (5) did not detect differences between the sexes in the various hematologic tests when comparing weanling animals. Curiously, for Delgado (3) the figures for the erythrocytes, hemoglobins and packed cell volumes of the males exceeded that of the females in the higher zones, the contrary occurring in the lower zones. Differences in the erythrogram for both sexes were found by Archer (1), Stan-kiewicz et al. (13) and Ferri et al. (4). Santos (11) did not confirm that, verifying otherwise these differences in the leukogram.

Considering the scarcity of data in the literature on the relationships between blood picture and performance, and also the disagreement of the authors on the influence of sex, this paper was planned in order to study both problems through the tests used for the evaluation of the erythrogram in Thoroughbred Horses.

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MATERIAL AND METHODS

The material consisted of blood of 120 Thoroughbred Horses with ages ranging between 3 and 5 years, submitted to regular exercises and similar regimen and lodged in Jockey Club of São Paulo. The animals were divided into two groups, which are called "winners" and "losers".

The selection for these groups was based on the times considered minimum and maximum for the 1,400 and 1,500 meters races, light sand; the ones which reached times inferior to the minimum index were called winners and the ones which went beyond the time established as maximum, were called losers.

The indexes for classification of the animals as winners and losers were calculated in function of the results obtained by 200 animals placed in 1st and 2nd places and by the same number placed in the two last posts in each of the races mentioned above.

The setting of the data was made in the archives of the Jockey Club's Commission of Races.

As only the result of the 1st placed is expressed in "time" and the results of the others, in "bodies" in relation to the first, a transposition of "bodies" in "time" was made, using the photochart which documents the races.

In order to verify the validity of the adopted criterion the scores obtained for the firsts and the lasts were previously analysed. The statistical analysis which was made for comparing these values, demonstrated a significant difference between the mean results at a significance level of 5%, making valid its employment in the selection of the animals.

After the 1,400 or 1,500 meters races, light sand, the time of the 1st placed was determined by a chronometer and that from the others, by the photochart, thus selecting the competitors with pre-established characteristics for the sampling.

The animals rested for 16-20 hours after the race, and then the blood was collected, skipping on purpose the horses which we knew had not been succeeded for adverse reasons, like, for example, indocility at the start.

The blood was obtained from the jugular vein in special siliconized flasks, containing an ethylenediaminetetraacetic acid disodium salt (E.D.T.A., sequestrene) in a solution of 10% in a proportion of 10 mg of salt to 5 ml of blood according to indications of Rosenfeld (10), in the morning, before the animals had received their meals, and avoiding anything that could excite them.

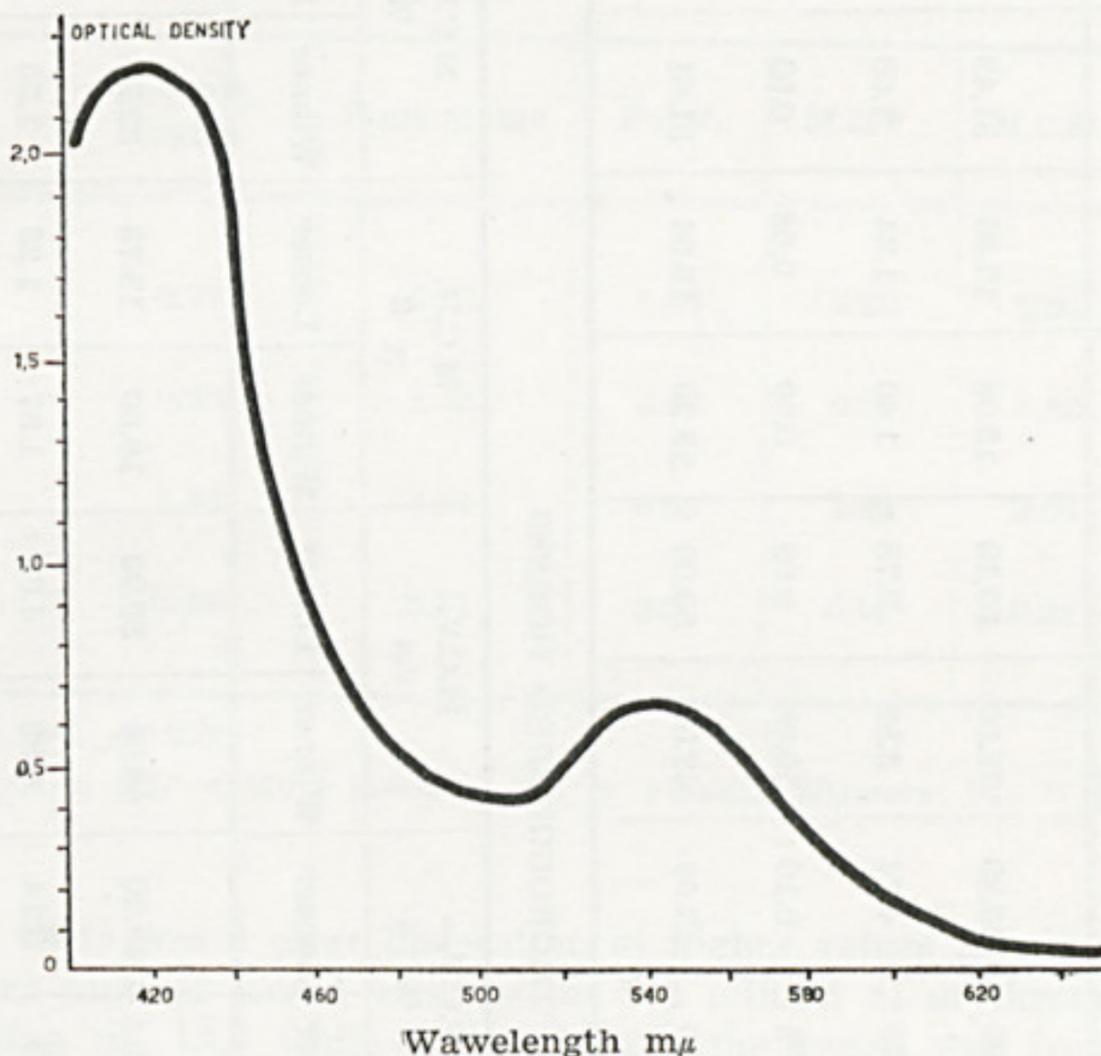
The following tests were carried out: counting of erythrocytes, determination of hemoglobin, packed cell volumes and the mean corpuscular hemoglobin concentration.

Erythrocyte counting — The blood was mechanically agitated for 2 minutes and then diluted in the red blood cell pipets, at 1/200 with Hayem's solution. After 2 minutes of mixing with a Clay-Adams agitator about 1/3 of the liquid of the pipet was discarded and the counting was made on a Neubauer counting chamber.

Hemoglobin — It was done with a spectrophotometer under the form of cyanomethemoglobin, as indicated by King & Wootton (7).

The spectrum of cyanomethemoglobin absorptions of thoroughbred horses blood was determined from the beginning in order to know the adequate wavelength for the analysis. The results showed that a wavelength of 540 milimicra should be used (Figure 1).

FIGURE 1
Absorption spectrum of cyanomethemoglobin
of thoroughbred horse.



Packed cell volumes — A Wintrobe tube was used to centrifugate the material for 30 minutes at 3,500 r.p.m.

Indexes (M.C.V., M.C.H., M.C.H.C.) were calculated after Wintrobe (18).

Statistical analysis — The distributions of all variables studied in each group were calculated.

The comparisons between winners and losers, and between sexes were carried on through the Student's test, after Snedecor (12).

The significance level adopted for all the tests was that of 5% (Table I).

RESULTS

The results are in the following tables. Figures 2 to 5 illustrate the dispersion of the results obtained for packed cell volumes and erythrocyte or mean corpuscular volume and erythrocytes for the winners and losers for both sexes.

DISCUSSION

The analysis of the results showed a significant difference in some of the tests between winners and losers. A more accurate examination allowed interesting observations. Thus, it was concluded that in the sample of males, the winners had a higher number of erythrocytes, nevertheless mean corpuscular volume and mean corpuscular hemoglobin were significantly lower. Regarding the number

TABLE I — ERYTHROGRAM IN MALE THOROUGHBRED HORSES

	Erythrocytes cmm		Hemoglobin g%		P.C.V. %		M.C.V. c.μ		M.C.H. % g		M.C.H.C. %	
	Winner	Looser	Winner	Looser	Winner	Looser	Winner	Looser	Winner	Looser	Winner	Looser
Mean	10.6 x 10 ⁶	9.7 x 10 ⁶	15.92	15.40	50.60	48.80	48.00	50.10	15.08	15.86	31.43	31.59
Standard deviation ...	1.35 x 10 ⁶	1.70 x 10 ⁶	0.75	1.40	2.75	4.74	3.89	3.78	1.40	1.34	1.00	1.59
Coef. of variation	0.13	0.17	0.05	0.09	0.05	0.10	0.08	0.08	0.09	0.08	0.03	0.05
Median	10.3 x 10 ⁶	9.8 x 10 ⁶	16.02	15.56	51.00	49.00	48.00	50.00	15.20	15.56	31.61	31.24

TABLE II — ERYTHROGRAM IN FEMALE THOROUGHBRED HORSES

	Erythrocytes cmm		Hemoglobin g%		P.C.V. %		M.C.V. c.μ		M.C.H. % g		M.C.H.C. %	
	Winner	Looser	Winner	Looser	Winner	Looser	Winner	Looser	Winner	Looser	Winner	Looser
Mean	9.24 x 10 ⁶	9.7 x 10 ⁶	14.79	14.40	45.70	46.20	49.60	50.20	16.80	15.78	32.28	31.21
Standard deviation ...	7.30 x 10 ⁵	1.70 x 10 ⁶	1.02	1.07	3.03	3.14	4.83	4.05	1.57	1.26	1.30	1.68
Coef. of variation	0.08	0.17	0.07	0.07	0.07	0.07	0.10	0.08	0.10	0.08	0.04	0.05
Median	9.4 x 10 ⁶	9.8 x 10 ⁶	15.00	14.53	46.00	47.00	49.50	49.00	16.06	15.29	32.05	31.24

TABLE III — ERYTHROGRAM — t VALUES FOR THE DIFFERENT CONTRASTS

Tests Contrasts	Erythro- cytes	Hemoglobin	P.C.V.	M.C.V.	M.C.H.	M.C.H.C.
MW x ML	2.27	1.79	1.80	2.20	2.20	0.46
FW x FL	0.20	1.44	0.63	0.52	0.89	2.73
MW x FW	4.86	4.91	6.53	1.42	2.64	2.71
ML x FL	0.40	3.11	2.50	0.10	0.24	0.90

Critic value of t , 5% = 2.00

MW = Male Winners; ML = Male Losers; FW = Female Winners; FL = Female Losers.

of erythrocytes, there was a clear dislocation of higher values favoring the winners, so that the lower number found was that of 9,4 million of erythrocytes per cubic millimeter, ranging till 13,1 while in the losers the range was from 7,2 to 11,7 million.

This fact is illustrated by Figure 2, which shows distribution of the frequency in the animals in relation to the mean corpuscular volume and to the number of erythrocytes.

These observations confirmed the findings of Patrushev (9) and Brenon (2), who noted that the best animals presented a higher number of erythrocytes. Nevertheless, the data obtained by the last author show great variability (in 207 Thoroughbred animals he found values over 10 and under 6,2 million for the groups of the 10 best, and under 6,2 for the group of the 10 worse, the mean result being 6,8). It is possible that the equines from which the material was collected were not similar in conditions to the ones used in this work.

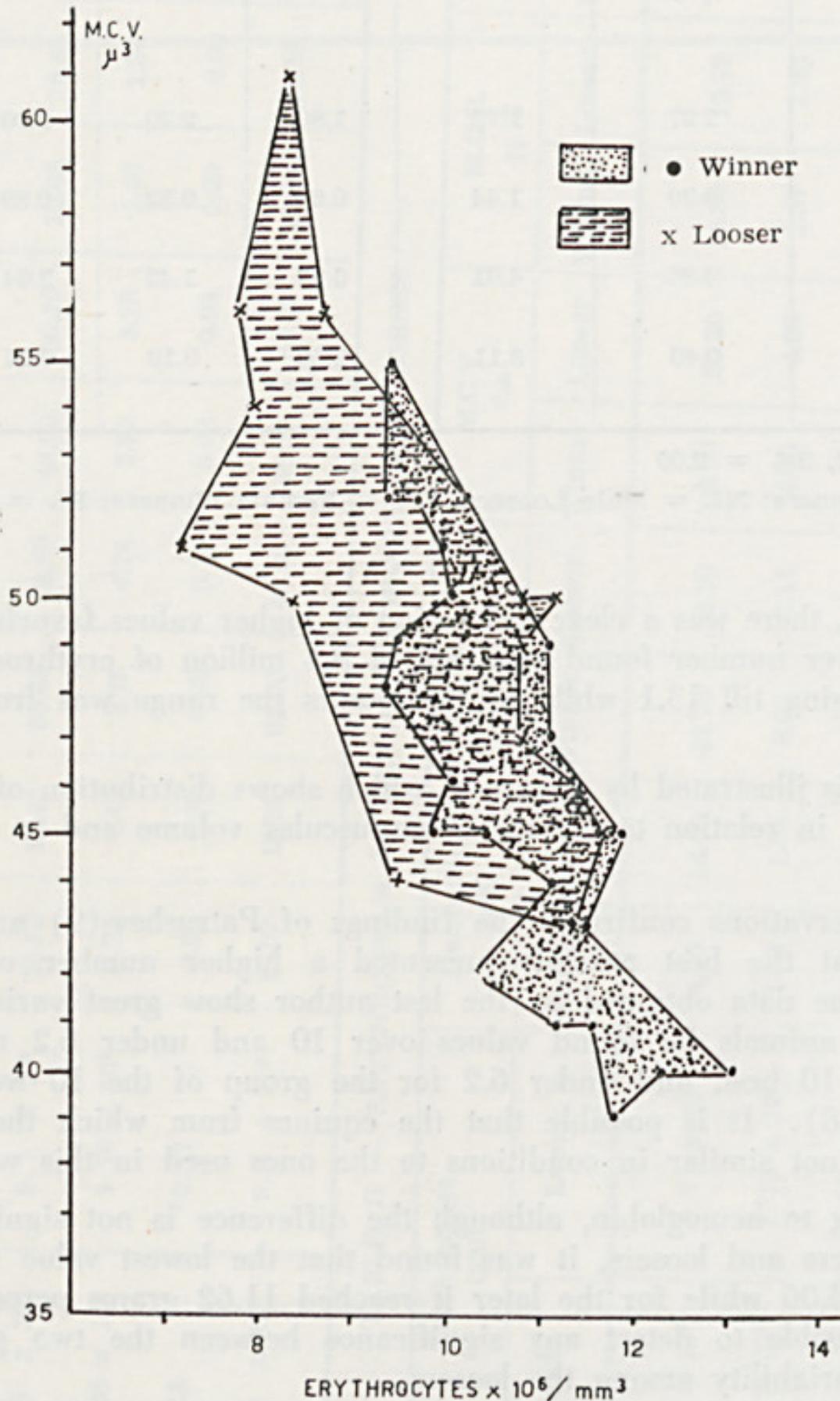
Concerning to hemoglobin, although the difference is not significant between the male winners and losers, it was found that the lowest value for the former were that of 14,06 while for the later it reached 11,62 grams percent. Probably, it was not feasible to detect any significance between the two groups because of the great variability among the losers.

The same considerations can be extended to the packed cell volumes of the two groups mentioned above, which is shown in figure 3.

The mean corpuscular hemoglobin concentration does not show any tendency to deviate in the males, in any category. This fact is in disagreement with the observations of Irvine (6) who without defining the sex, asserted that the best animals presented erythrocytes with higher saturation of hemoglobin. The same author, examining the blood of 30 of the quickest racers among 184 animals, found much smaller values than the ones here marked for hemoglobin and packed cell volumes. Besides, the mean value in these with reference to this sample and to the total group of equine, roughly did not present differences and it must be pointed out that the data obtained were very low, which seems to indicate that his sample is not adequate for this kind of study.

FIGURE 2

Frequency distribution of thoroughbred males, winner and loser, in relation to the mean corpuscular volume (M.C.V.) and the erythrocytes number



Analysing now the results found for the females, in respect to the already commented tests, it was noticed that only the mean corpuscular concentration shows significant difference with a higher value for the winners. No explanation could be suggested for these observations as it did not occur in the males. Concerning the tests in which the results did not differ significantly, the main reason seems to be that they showed a more compact distribution for the winners, as they did not reach very high values, mainly in the number or erythrocytes. Figure 4 and 5 show this aspect for the erythrocytes, packed cell volumes and mean corpuscular volume.

Therefore, in spite of the losers been able to show high blood values, which in a certain way confounds the perception of the differences, the winners, in particular the males, characterize themselves always for results above a minimum relatively high for the majority of the tests, the contrary occurring with the mean corpuscular hemoglobin. The differences are so accentuated for these two last tests and for global counting of erythrocytes in the males, that they differ significantly in both experimental groups. These facts indicate that the animals which have these characteristics are with great probability the fittest. Naturally, the capacity from the hematologic point of view does not necessarily demonstrate that all these animals are always winners, because other factors take part in the final result.

In reference to the results of the research for the evaluation of the sex's influence over the blood picture it was observed that the number of erythrocytes was significantly higher for the males in the category of winners, differences having not been found in the losers.

The study of the tables permits understanding of these facts apparently in disagreement, since, between the losers, the number of erythrocytes showed relatively high frequency of low values, which did not occur with the winners.

FIGURE 3
Frequency distribution of thoroughbred males, winner and loser, in relation to the hematocrit and the erythrocytes number

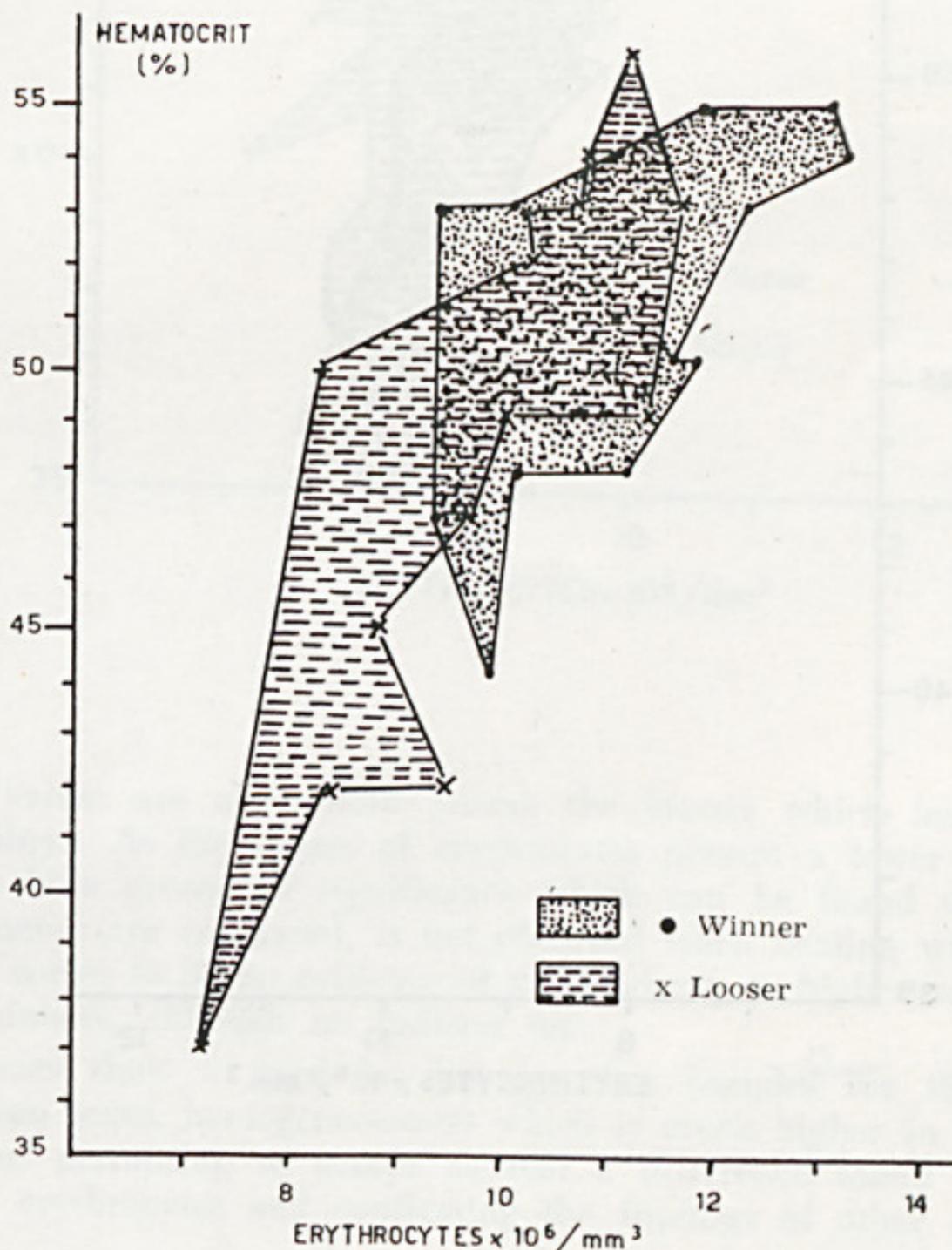


FIGURE 4

Frequency distribution of thoroughbred females, winner and loser, in relation to the mean corpuscular volume (M.C.V.) and the erythrocytes number

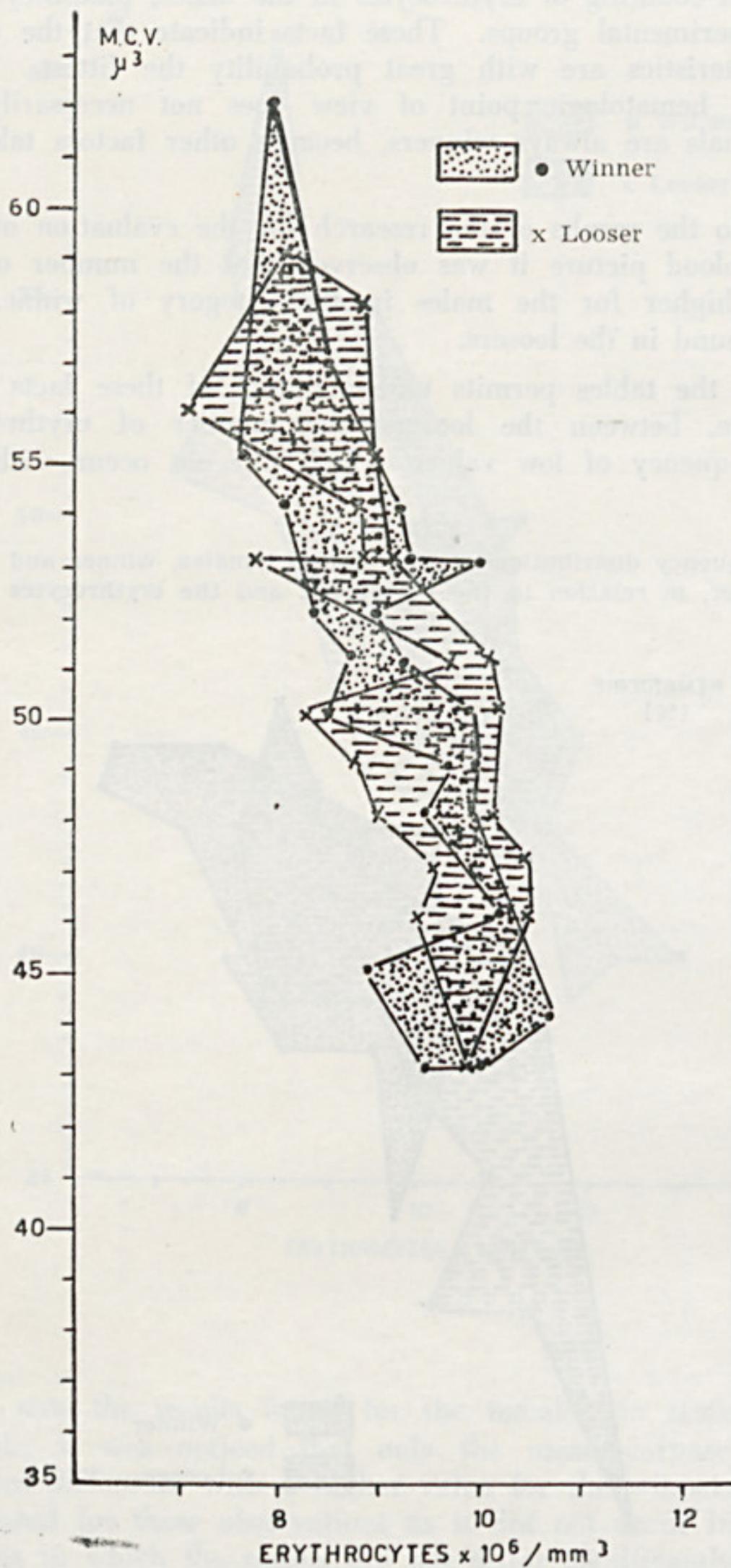
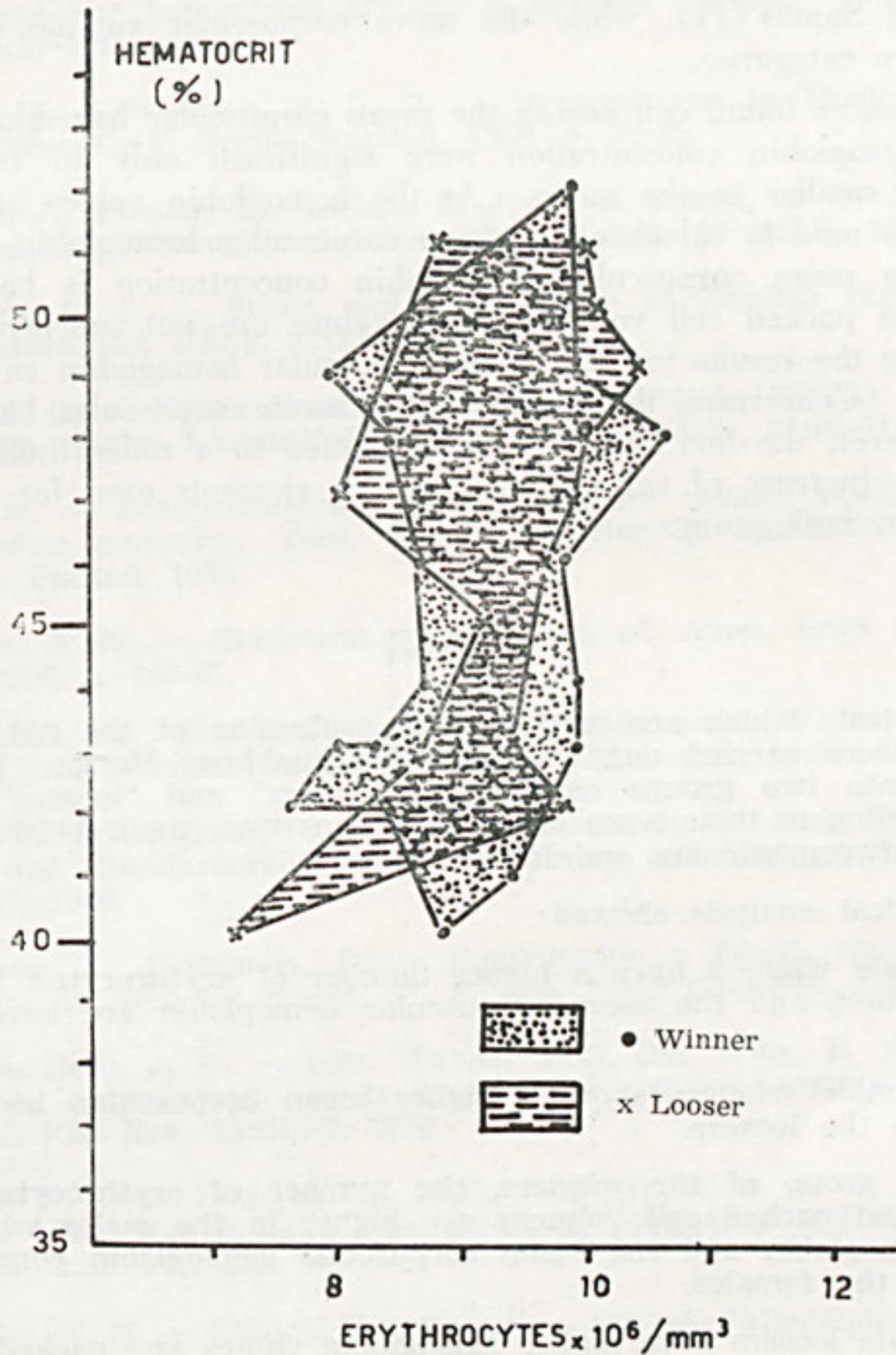


FIGURE 5

Frequency distribution of thoroughbred females, winner and loser, in relation to the hematocrit and the erythrocytes number



Besides, high values are also found among the losers which leads them to a greater variability. As the values of erythrocytes present a lower dispersion for the females in both groups, a significance which can be found when the male and female winners are compared, is not observed when dealing with the losers. Thus, this fact comes to be an evidence of the tendency to higher values presented by the male winners, although an indirect one.

These aspects show a need for homogeneous samples for the hematologic contrasts, between sexes, homogeneousness which is much higher in the population of winners, thus permitting to accept as real a difference found in relation to the number of erythrocytes and confirming the findings of other authors (1, 8, 13, 17).

The hemoglobin is seen significantly higher in the males, both winners and losers which is in agreement with Stankiewicz et al. (13) but not with the observation of Archer (1), Santos (11) and Van Den Berg (16).

The packed cell volumes behaved similarly to the hemoglobin, which confirms the findings of Santos (11), while the mean corpuscular volume did not differ between the two categories.

The differences found concerning the mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were significant only in relation to the winners, being smaller in the males. As the hemoglobin values and number of erythrocytes are used to calculate the mean corpuscular hemoglobin, and the computation of the mean corpuscular hemoglobin concentration is based upon the hemoglobin and packed cell volumes, their values are not independent and one could anticipate the results for the mean corpuscular hemoglobin as it was shown by Archer (1). Concerning the results of the mean corpuscular hemoglobin concentration however, the fact can only be attributed to a redistribution of the variables with an increase of variability, since the elements used for its calculation differ in sex for both groups.

SUMMARY

The main tests which are used for the evaluation of the red series of the blood picture were carried out with 120 Thoroughbred Horses. These equines were divided into two groups considered "winners" and "losers". They were separated according to their sexes and comparisons were made between males and females and between winners and losers.

The statistical analysis showed:

- 1) The male winners have a higher number of erythrocytes, but the mean corpuscular volume and the mean corpuscular hemoglobin are lower than those of the losers.
- 2) The female winners show a higher mean corpuscular hemoglobin concentration than the losers.
- 3) In the group of the winners, the number of erythrocytes, the hemoglobin values and packed cell volumes are higher in the males while the mean corpuscular hemoglobin and the mean corpuscular hemoglobin concentration are lower than in the females.
- 4) The male losers have higher hemoglobin values and packed cell volumes than the females.

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