ARE NEGATIVE BREEDING TRAITS IN ANDALUSIAN HORSES CORRELATED WITH COAT COLOR AND CARTHUSIAN ANCESTRY?

By

Maria Laura Mandina

A Thesis Submitted to the Faculty of

The Wilkes Honors College

in Partial Fulfillment of the Requirements for the Degree of

Bachelor of Arts in Liberal Arts and Sciences

with a Concentration in Biology

Wilkes Honors College of

Florida Atlantic University

Jupiter, Florida

May 2008

ARE NEGATIVE BREEDING TRAITS IN ANDALUSIAN HORSES CORRELATED WITH COAT COLOR AND CARTHUSIAN ANCESTRY?

By

Maria Laura Mandina

This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Jon Moore, and has been approved by the members of her supervisory committee. It was submitted to the faculty of The Honors College and was accepted in partial fulfillment of the requirements for the degree of Bachelor of Arts in Liberal Arts and Sciences.

SUPERVISORY COMMITTEE:

_____

Dr. Jon Moore

_____

Dr. James Wetterer

_____

Dean, Wilkes Honors College

_____

Date

Abstract

Author:	Maria Laura Mandina
Title:	Are negative breeding traits in Andalusian horses correlated with coat color and Carthusian ancestry?
Institution:	Wilkes Honors College of Florida Atlantic University
Thesis Advisor:	Dr. Jon Moore
Degree:	Bachelor of Arts in Liberal Arts and Sciences
Concentration:	Biology
Year:	2008

Andalusian horses can be white (gray), bay (reddish-brown with a black mane, tail and legs), or black in color. Historically white horses were most highly valued, but recently there has been an increased demand for black horses. Because of the long preference, white Carthusian Andalusians are of higher quality than non-white and non-Carthusian Andalusian horses. For my thesis, I examined whether negative breeding traits in Andalusian horses are correlated with coat color and Carthusian ancestry. This hypothesis was tested in two different manners based on my observations and on the observations of Spanish judges throughout the centuries. The first method used was a program called MELPI in which two hundred and fifty horses were randomly chosen and researched. The second method consisted of my attendance of two horse shows in Florida in which 50 horses were randomly selected. The results for both methods of evaluation supported my hypothesis that negative breeding traits in Andalusian horses are genetically correlated to the color genes.

To my mommy and daddy, my little sister, Josh, Avi, Yaya, UA y Abuelito Leo

Table of Contents

List of Tables

List of Figures

List of Figures Continued

Introduction

Figure 1: The Andalusian Horse (from Vavra 2004)

The Andalusian horse, also known as the Spanish horse or "El Caballo de Pura Raza Espanola (PRE)," is a very ancient and rare breed dating back over 25,000 years (Llamas 1997) and is one of the oldest horse breeds in the modern world (Molina et al. 1999). The Andalusian evolved in the hilly and rugged area of Spain (Royo et al. 2005). Fighting for survival and grazing over this rough terrain led to the development of a perfectly proportioned and picturesque horse with catlike agility and impulsiveness that has influenced the development of more breeds than any other horse with the exception of the Arabian and the Barb (Molina et al. 1999). The Andalusian is strongly built, yet extremely elegant. He is a most impressive sight, with its sculptural beauty and proud bearing (L.I.M.P.R.E. 2000). The Spanish horse is strongly coveted by his country as the Spanish government has for years monitored and regulated the breeding of this magnificent animal through the stud book. Every year, at the age of three, young stallions and mares were judged on whether they could enter the stud book, and thus, be

eligible for breeding. The Andalusian exists in many different colors; however, until recently, only some of the colors were accepted into the stud book. At first, only white/gray horses were accepted which explains the fact that 80% of registered Andalusians are white (gray). Bay horses, horses that are reddish-brown in color with a black mane, tail and legs, were second to be included and make up 10% of registered Andalusians. Finally, black horses were upgraded making up 5% of the registered breed. Recently, within the last few years, the Spanish Stud Book allowed the inclusion of Chestnut horses and a few other colors that make up the last 5% of the registered breed (Llamas 1997).

The Carthusian, also called the Cartujano or Terry line, is a subset of the Andalusian; however, the two are considered one breed and have no genetic distinction (Valera et al. 2005). The Carthusian is one of Spain's oldest and purest lines bred by religious orders, and can be traced back the furthest in the stud book since the XVth century (Valera et al. 2005). Through a time period of Spanish turmoil, wars, and political changes, the Andalusian horse was being sold and moved around the country and into different countries. A man named Andres Zamora and his brother owned several spectacular Spanish mares and an amazing stallion named Esclavo, who is known as the founding stallion to the Carthusian line. Through this unsteady time period, Esclavo was sold to Portugal; however, his offspring and descendants were given to a man by the name of Don Pedro Picado in 1736. It was he who turned the prized horses over to the Carthusian monks who guarded the bloodlines for centuries even defying a royal order to introduce different blood. Today Carthusian horses are raised in state-owned stud farms around Cordoba, Jerez de la Frontera, and Badajoz (Biology Daily 2007).

For my thesis, I evaluated whether coat color correlates with the quality of Andalusian horses. The purpose I wished to examine was whether white (gray) Andalusian horses born of Carthusian bloodlines are of higher quality than any other color accepted by the breed. This is necessary knowledge in order to further improve the Spanish horse through educated breeding with the incorporation of certain bloodlines and colors beneficial to the advancement of the breed. This information can be utilized by breeders around the world to add both the purity of the Carthusian line and the quality they offer to improve their stock and thereby improve the Andalusian himself.

Materials and Methods

The Materials used for this study were: 300 randomly selected Andalusian horses, the Spanish Stud Book, and the MELPI program (MELPI 2007) developed by the Spanish government and breeders in order to further organize horse and breeder information.

A strict scoring method was followed in which five significant conformational points of the body were focused on. These points of focus included the neck, the head which consists of the face, eyes, and ears, the croup (hind quarters), the back, and the legs. The face of the Spanish horse is supposed to have a slight, elegant Roman-nosed profile (Vavra 2004) and should be long, straight, narrow, smooth, and lean becoming narrower towards the muzzle (Llamas 1997). The ears should be mobile, fairly broad at the base, short in length, fairly strong and well separated. The outer line of the ear, from base to tip, is a perfect curve. The inner line is similar; however, just before the tip the curve is inverted, giving a marked scooped-in effect. The tip is never pointed, but blunt (Llamas 1997). The eyes of the Spanish horse are large and black with full lashes and marked depressions above. They are set well below the ears that are level with the surface of the face, not sunken or bulging. Spanish horses are known for their kind, lively, and attractive eyes alert to whatever might be before them and always looking forward (Llamas 1997).

Figure 2: The Eye Figure 3: The Eye Figure 4: The Face Figure 5: The Ears

[from Vavra 2004]

One of the most distinctive traits of the Andalusian horse is his long, arrogant, elegant and arched neck that is high and in proportion to the horse's size, rises from its base and becomes narrower towards the head. The neck should be erect and not too thick springing from the shoulders, not the withers. The throat should be fine and unobstructed (Llamas 1997). There are a few critical faults that must be taken into consideration when judging the neck of an individual. The most important fault is that known as gato, or fallen crest. This is a condition in which the crest, the upper part of the neck running along the edge and separated from the neck by a groove or depression along its lower part, is too heavy with excess fat and through time falls to one side. Another condition of particular importance is an inverted neck, or in other words, a neck that is convex on the bottom line rather than concave (Llamas 1997).

Figure 6: The Neck and Throat

Figure 7: The Crest

Figure 8: Fallen Crest (Gato) [Equiandalusion Onli

Figure 9: Inverted Neck [Equiandalusian Online]

The back of the horse is the region lying between the withers, the loins and the ribs. In the Andalusian horse, the back should be short in length and flat. There is a conformational fault known as a "swayed back" which is a term used to define a horse's back in which there is a dip and the spine itself is significantly lower than the withers and the hind quarters of the horse.

Figure 10: Perfectly Proportioned Back

Figure 11: Swayed Back [Equiandalusian Online]

Figure 12: Long Back [Equiandalusian Online]

Figure 13: Overly-Short Back [Equiandalusian Online]

The croup of the Spanish horse should be long, broad and well rounded. Flat croups with a high-set tail are unacceptable as are insufficient croups in which the bone in the middle protrudes, and double croups in which there is an indenture on the top-line of the hindquarters separating it into two distinct parts (Llamas 1997).

Figure 14: Perfectly Rounded & Proportioned Croup

Figure 15: Flat Croup [Equiandalusian Online]

Figure 16: Insufficient Croup [Equiandalusian Online]

Figure 17: Double Croup [Equiandalusian Online]

The legs should be straight and well-proportioned in coordination with body size. There are many faults associated with the legs of a horse. Overly small legs and hooves in comparison to a large upper body are heavy faults as are cow-hocked or pigeon-toed individuals. Deviated hooves, camped over, camped under, flat footed, back at the knee, over at the knee, behind himself, and goat's leg are just a few of the defaults affecting the legs of a horse (Llamas 1997).

Figure 18: Well Proportioned Legs

Figure 19: Hooves Too Small

Figure 20: Cow Hocked

Figure 21: Pigeon Toed

Figure 22: Deviated Hoof

Figure 23: Camped Over

Figure 24: Camped Under

Figure 25: Flat Footed

Figure 26: Back at the Knee

Figure 27: Over at the Knee

Figure 28: Behind Himself

Figure 29: Goat's Leg

[The previous twelve images were all downloaded off Equiandalusian Online]

It is possible that a horse may have multiple faults in any of those given focal points; however, if there was any sort of problem identified in any of these areas, it was noted that the individual had a fault in that conformational point of his or her body. Multiple conformational defaults in one of the points of focus were not taken into consideration and were thus acknowledged with the first fault located in that area.

This study was performed in two different manners in order to better come to a conclusion about the question at hand. The first part of the study was performed using the program MELPI. MELPI is a software designed by A.N.C.C.E. which is the association of breeders in Spain, in order to make the contents of the stud book and other information concerning individual Andalusian horses and breeders more accessible to breeders around the world. It is currently comprised of over 900 breeders in over 29 countries and includes the horses owned by each breeder and all the information known about that horse (MELPI, S.L. 2007). Two hundred fifty horses were randomly selected from the program. Their conformational faults were recorded through picture and video footage and notes taken by the judges that have examined them in the past. Their coat color was noted followed by extensive research of their background and lineages to pinpoint whether or not they were of Carthusian ancestry. Finally, their level of classification and breeding quality as judged by the Spanish government was researched and recorded.

The second part of the study was carried out at an Andalusian horse show in which fifty horses were randomly selected and judged by a qualified and experienced breeder. Their conformational faults were once again recorded in the same manner with the same qualifications as the first method of study, their coat color was again noted, their bloodlines fully researched, and the level of breeding quality as approved by the Spanish government was also researched for each individual. Following the critique of these fifty horses, was the task of researching the bloodlines of each individual to determine their ancestry, their scores upon examination, and their level of quality as approved by the Spanish government.

Results

Method 1: The horseshow results.

As evidenced by the results listed in Table 1, of the 50 randomly selected horses, 27 were white with only 10 of those with white Carthusian ancestry, 14 were bay with 3 of white Carthusian ancestry, and 9 were black with two of white Carthusian ancestry. Of the 27 white horses, 37% of them had 5 faults; however, only 4% of the white horses of the Carthusian lines had 5 faults. Of the 14 bay horses, 57% of them had 5 faults; however, only 7% of the Carthusian bays had 5 faults. Of the 9 black Andalusians, 78% of the horses had over 5; however, only 11% of the Carthusian bred blacks had 5 faults.

Table 1: Results from the horseshow.

HORSE	LEVEL OF QUALITY PER SPAIN 0,1,2,3	WHITE CARTHUSIAN BLOOD?	COLOR	NECK	FACE/EARS	CROUP	BACK	LEGS	Total Faults
1	1	NO	WHITE	X	X		X	X	4
2	2	YES	WHITE				X		1
3	1	NO	WHITE	X	X	X	X	X	5
4	1	YES	WHITE	X	X	X	X	X	5
5	1	NO	WHITE		X	X	X		3
6	1	NO	WHITE	X	X	X	X	X	5
7	1	NO	WHITE	X	X	X	X	X	5
8	1	YES	WHITE					X	1
9	1	NO	WHITE	X	X	X	X	X	5
10	1	NO	WHITE	X	X	X	X	X	5
11	1	YES	WHITE	X					1
12	1	NO	WHITE	X	X	X	X	X	5
13	1	YES	WHITE			X			1
14	1	NO	WHITE		X		X		2
15	1	YES	WHITE				X		1
16	1	NO	WHITE	X	X		X		3
17	1	NO	WHITE	X	X	X	X	X	5
18	1	YES	WHITE			X			1
19	1	NO	WHITE	X	X	X	X	X	5

20	1	YES	WHITE			X			1
21	1	NO	WHITE	X	X				2
22	2	YES	WHITE				X		1
23	2	YES	WHITE					X	1
24	1	NO	WHITE	X	X	X	X	X	5
25	1	NO	WHITE	X		X			2
26	1	NO	WHITE	X	X	X			3
27	1	NO	WHITE	X			X	X	3
28	1	NO	BAY	X	X	X	X	X	5
29	1	NO	BAY	X	X	X	X	X	5
30	1	NO	BAY	X	X		X		3
31	1	NO	BAY	X	X	X	X	X	5
32	1	NO	BAY	X	X	X			3
33	1	NO	BAY	X	X	X	X	X	5
34	1	NO	BAY	X	X	X	X	X	5
35	1	NO	BAY	X	X		X	X	4
36	1	NO	BAY	X	X	X	X	X	5
37	1	NO	BAY			X	X	X	3
38	1	YES	BAY	X	X	X	X	X	5
39	2	YES	BAY			X		X	2
40	1	YES	BAY		X		X		2
41	1	NO	BAY	X	X	X	X	X	5
42	0	NO	BLACK	X	X	X	X	X	5
43	1	NO	BLACK	X	X	X	X	X	5
44	1	NO	BLACK	X	X	X	X	X	5
45	1	NO	BLACK	X	X	X	X	X	5
46	1	NO	BLACK	X	X	X	X	X	5
47	1	NO	BLACK	X	X	X	X	X	5
48	1	YES	BLACK	X	X	X	X	X	5
49	1	NO	BLACK	X	X		X	X	4
50	1	YES	BLACK		X				1

Method 2: MELPI software results.

Of the 250 horses selected (Table 2), 174 were white, with 72 of Carthusian lines, 51 were bay, with 19 of Carthusian lines, and 25 were black, with 7 of Carthusian lines. Of the 174 white horses, 43 (25%) had 5 faults and of the 72 Carthusians only 13 (18%) had 5 faults. Of the 51 bay horses, 23 (45%) had 5 faults and of the 19 Carthusians 7 (37%) had 5 faults. Of the 25 black horses, 18 (72%) had 5 faults and of the 7 Carthusians only 3 (43%) had 5 faults.

Table 2: Scoring for the 250 horses selected from MELPHI.

HORS	LEVEL	WHITE	COLO	NEC	FACE/EAR	CROU	BAC	LEG	Tota

E	OF QUALITY PER SPAIN 0,1,2,3	CARTHUSIAN BLOOD?	R	K	S	P	K	S	l Fault
1	1	YES	WHITE	X			X		2
2	1	YES	WHITE		X			X	2
3	1	YES	WHITE	X	X	X	X	X	5
4	1	YES	WHITE					X	1
5	2	YES	WHITE	X					1
6	2	YES	WHITE				X		1
7	1	YES	WHITE	X	X	X	X	X	5
8	2	YES	WHITE			X			1
9	1	YES	WHITE	X	X	X	X	X	5
10	1	YES	WHITE	X	X				2
11	1	YES	WHITE					X	1
12	1	YES	WHITE	X	X	X	X	X	5
13	1	YES	WHITE	X	X	X	X	X	5
14	2	YES	WHITE				X		1
15	1	YES	WHITE	X	X	X	X	X	5
16	1	YES	WHITE	X					1
17	1	YES	WHITE		X	X			2
18	1	YES	WHITE	X	X	X	X	X	5
19	1	YES	WHITE	X	X				2
20	2	YES	WHITE			X			1
21	1	YES	WHITE	X		X	X	X	4
22	2	YES	WHITE		X				1
23	1	YES	WHITE	X	X	X	X	X	5
24	2	YES	WHITE	X					1
25	1	YES	WHITE		X	X			2

26	2	YES	WHITE		X		X		2
27	1	YES	WHITE	X	X				2
28	1	YES	WHITE			X	X		2
29	1	YES	WHITE				X	X	2
30	2	YES	WHITE			X			1
31	1	YES	WHITE	X	X				2
32	2	YES	WHITE			X	X	X	3
33	1	YES	WHITE	X	X	X	X	X	5
34	2	YES	WHITE					X	1
35	1	YES	WHITE			X	X		2
36	2	YES	WHITE					X	1
37	2	YES	WHITE	X	X				2
38	2	YES	WHITE				X		1
39	1	YES	WHITE	X	X	X	X	X	5
40	1	YES	WHITE		X	X			2
41	1	YES	WHITE	X	X				2
42	1	YES	WHITE			X	X	X	3
43	1	YES	WHITE	X			X		2
44	1	YES	WHITE	X		X			2
45	1	YES	WHITE		X		X		2
46	1	YES	WHITE		X	X			2
47	1	YES	WHITE	X	X	X			3
48	1	YES	WHITE	X	X	X	X	X	5
49	1	YES	WHITE			X			1
50	2	YES	WHITE	X					1
51	1	YES	WHITE		X		X		2
52	1	YES	WHITE	X	X				2
53	1	YES	WHIT			X	X		2

			E						
54	1	YES	WHITE					X	1
55	2	YES	WHITE				X		1
56	1	YES	WHITE	X		X	X	X	4
57	1	YES	WHITE	X	X	X			3
58	1	YES	WHITE			X	X		2
59	2	YES	WHITE	X				X	2
60	1	YES	WHITE			X			1
61	1	YES	WHITE	X	X	X			3
62	1	YES	WHITE			X			1
63	1	YES	WHITE	X	X	X	X	X	5
64	1	YES	WHITE		X	X			2
65	2	YES	WHITE				X	X	2
66	1	YES	WHITE	X	X				2
67	1	YES	WHITE			X	X		2
68	1	YES	WHITE	X	X	X	X	X	5
69	1	YES	WHITE			X			1
70	1	YES	WHITE	X	X				2
71	2	YES	WHITE			X			1
72	1	YES	WHITE	X	X	X		X	4
73	1	NO	WHITE	X			X		2
74	1	NO	WHITE		X		X		2
75	1	NO	WHITE	X	X	X			3
76	1	NO	WHITE		X	X	X		3
77	1	NO	WHITE	X	X			X	3
78	2	NO	WHITE	X					1
79	1	NO	WHITE			X	X		2
80	1	NO	WHITE	X	X	X	X	X	5

81	1	NO	WHITE	X	X				2
82	1	NO	WHITE	X	X	X	X	X	5
83	1	NO	WHITE				X		1
84	1	NO	WHITE		X				1
85	1	NO	WHITE	X	X	X	X	X	5
86	2	NO	WHITE		X				1
87	1	NO	WHITE			X			1
88	1	NO	WHITE	X	X	X	X	X	5
89	1	NO	WHITE			X			1
90	1	NO	WHITE	X	X	X	X	X	5
91	1	NO	WHITE	X	X				2
92	1	NO	WHITE			X	X		2
93	1	NO	WHITE	X	X	X	X	X	5
94	1	NO	WHITE			X	X		2
95	1	NO	WHITE	X	X				2
96	1	NO	WHITE	X	X	X	X	X	5
97	1	NO	WHITE		X	X			2
98	1	NO	WHITE	X	X	X	X		4
99	1	NO	WHITE		X	X	X	X	4
100	1	NO	WHITE		X				1
101	1	NO	WHITE		X			X	2
102	1	NO	WHITE	X	X	X	X	X	5
103	1	NO	WHITE		X	X	X		3
104	1	NO	WHITE	X	X	X	X	X	5
105	1	NO	WHITE	X	X	X			3
106	1	NO	WHITE	X	X				2
107	1	NO	WHITE				X	X	2
108	1	NO	WHIT	X	X	X			3

			E						
109	1	NO	WHITE	X	X	X	X	X	5
110	1	NO	WHITE				X	X	2
111	1	NO	WHITE	X	X	X	X	X	5
112	1	NO	WHITE			X	X		2
113	1	NO	WHITE	X	X	X	X	X	5
114	1	NO	WHITE		X	X			2
115	1	NO	WHITE	X	X				2
116	1	NO	WHITE		X	X	X		3
117	1	NO	WHITE	X	X	X	X	X	5
118	1	NO	WHITE			X	X	X	3
119	1	NO	WHITE	X	X	X			3
120	1	NO	WHITE		X	X	X		3
121	1	NO	WHITE	X	X	X	X	X	5
122	1	NO	WHITE	X	X	X	X		4
123	1	NO	WHITE	X	X				2
124	1	NO	WHITE			X	X		2
125	1	NO	WHITE	X	X	X	X	X	5
126	1	NO	WHITE		X	X			2
127	1	NO	WHITE	X	X		X	X	4
128	1	NO	WHITE	X	X	X	X	X	5
129	1	NO	WHITE				X	X	2
130	1	NO	WHITE				X		1
131	1	NO	WHITE	X	X	X	X	X	5
132	1	NO	WHITE			X			1
133	2	NO	WHITE	X					1
134	1	NO	WHITE	X	X	X	X	X	5
135	1	NO	WHITE				X		1

136	1	NO	WHITE	X	X	X	X	X	5
137	1	NO	WHITE		X	X			2
138	1	NO	WHITE	X	X	X	X	X	5
139	1	NO	WHITE		X	X			2
140	1	NO	WHITE	X	X	X	X	X	5
141	1	NO	WHITE	X	X	X	X	X	5
142	1	NO	WHITE		X	X			2
143	1	NO	WHITE	X	X				2
144	1	NO	WHITE				X	X	2
145	1	NO	WHITE	X	X	X	X	X	5
146	1	NO	WHITE			X	X	X	3
147	1	NO	WHITE	X	X				2
148	1	NO	WHITE	X	X	X	X	X	5
149	2	NO	WHITE			X	X		2
150	1	NO	WHITE	X	X				2
151	1	NO	WHITE				X	X	2
152	1	NO	WHITE	X	X	X	X	X	5
153	2	NO	WHITE		X				1
154	1	NO	WHITE	X	X	X	X	X	5
155	1	NO	WHITE				X	X	2
156	1	NO	WHITE	X	X	X			3
157	1	NO	WHITE				X	X	2
158	1	NO	WHITE			X	X	X	3
159	1	NO	WHITE	X	X				2
160	1	NO	WHITE			X	X		2
161	1	NO	WHITE	X	X	X	X	X	5
162	1	NO	WHITE			X	X		2
163	1	NO	WHIT	X	X				2

			E						
164	1	NO	WHITE		X	X			2
165	1	NO	WHITE	X	X	X	X	X	5
166	1	NO	WHITE		X	X			2
167	1	NO	WHITE	X	X	X	X	X	5
168	1	NO	WHITE	X	X				2
169	1	NO	WHITE		X	X			2
170	1	NO	WHITE	X	X			X	3
171	1	NO	WHITE		X	X	X		3
172	1	NO	WHITE	X	X	X	X	X	5
173	1	NO	WHITE		X	X	X	X	4
174	1	NO	WHITE	X	X		X	X	4
175	1	YES	BAY			X	X		2
176	1	YES	BAY	X	X				2
177	1	YES	BAY	X	X	X	X	X	5
178	1	YES	BAY		X	X			2
179	1	YES	BAY	X	X	X	X	X	5
180	1	YES	BAY				X		1
181	1	YES	BAY	X	X	X	X	X	5
182	1	YES	BAY	X	X	X	X	X	5
183	2	YES	BAY			X			1
184	1	YES	BAY	X	X				2
185	1	YES	BAY	X	X	X	X	X	5
186	1	YES	BAY	X	X				2
187	1	YES	BAY				X		1
188	2	YES	BAY			X			1
189	1	YES	BAY	X	X	X	X	X	5
190	1	YES	BAY		X	X			2
191	1	YES	BAY	X	X				2
192	1	YES	BAY	X	X	X	X	X	5
193	2	YES	BAY	X					1
194	1	NO	BAY			X	X		2
195	1	NO	BAY	X	X	X			3
196	1	NO	BAY			X	X	X	3
197	1	NO	BAY	X	X	X	X	X	5
198	1	NO	BAY	X	X		X		3
199	1	NO	BAY	X	X	X	X	X	5
200	1	NO	BAY	X	X	X	X	X	5
201	1	NO	BAY	X	X	X	X	X	5
202	1	NO	BAY		X	X			2
203	1	NO	BAY	X	X	X	X	X	5
204	1	NO	BAY	X	X	X	X	X	5
205	1	NO	BAY			X	X		2

206	1	NO	BAY	X	X	X	X	X	5
207	1	NO	BAY		X	X			2
208	2	NO	BAY	X	X	X			3
209	1	NO	BAY		X	X	X	X	4
210	1	NO	BAY	X	X	X	X	X	5
211	1	NO	BAY		X	X	X		3
212	1	NO	BAY	X	X	X	X	X	5
213	1	NO	BAY		X	X	X	X	4
214	2	NO	BAY	X	X				2
215	1	NO	BAY	X	X	X	X	X	5
216	1	NO	BAY	X	X	X	X	X	5
217	1	NO	BAY	X	X	X	X	X	5
218	1	NO	BAY		X	X	X	X	4
219	1	NO	BAY	X	X	X	X	X	5
220	1	NO	BAY	X	X	X	X	X	5
221	1	NO	BAY		X	X			2
222	1	NO	BAY	X	X	X	X	X	5
223	1	NO	BAY	X	X				2
224	0	NO	BAY	X	X	X	X	X	5
225	1	NO	BAY	X	X	X			3
226	1	YES	BLACK	X	X	X	X	X	5
227	2	YES	BLACK		X				1
228	1	YES	BLACK				X		1
229	1	YES	BLACK	X	X	X	X	X	5
230	1	YES	BLACK	X	X	X			3
231	1	YES	BLACK	X	X	X	X	X	5
232	2	YES	BLACK		X	X			2
233	1	NO	BLACK	X	X	X	X	X	5
234	1	NO	BLACK	X	X	X	X	X	5
235	1	NO	BLACK	X	X	X	X	X	5
236	1	NO	BLACK	X	X	X	X	X	5
237	0	NO	BLACK	X	X	X	X	X	5
238	1	NO	BLACK	X	X	X	X	X	5
239	1	NO	BLACK	X	X	X	X	X	5
240	1	NO	BLACK	X	X				2
241	1	NO	BLACK	X	X	X	X	X	5
242	1	NO	BLACK	X	X	X	X	X	5

243	1	NO	BLACK	X	X	X	X	X	5
244	1	NO	BLACK	X	X			X	3
245	1	NO	BLACK	X	X	X	X	X	5
246	1	NO	BLACK	X	X	X	X	X	5
247	1	NO	BLACK		X	X			2
248	1	NO	BLACK	X	X	X	X	X	5
249	0	NO	BLACK	X	X	X	X	X	5
250	1	NO	BLACK	X	X	X	X	X	5

Discussion

Through this study, I conclude that the color of the Andalusian horse is connected to the quality of the breed. White Andalusian horses, paying no attention to lineages, had fewer negative characteristics and faults as did horses of any other color. The Carthusian Andalusians of each color possessed significantly fewer faults than non-Carthusian horses of the same color. The white Carthusian bred horses, for example, exhibited the fewest faults and the best breeding quality ratings as determined by the Spanish government. Using program MELPI to do some extra research on the subject, I found that most of Spain's major champions have been white, and most from Carthusian backgrounds.

These results do relate to existing theory as it is evident that Carthusian horses are the purest Andalusian line in existence and horses bred for quality and not for color are of better quality; therefore, the two combined would undoubtedly produce the best offspring. The best horses of color arise accidentally when a breeder selects his mates in a quest for quality paying no attention to color but to ancestral backgrounds and conformational details of each horse. This is why when looking at the results of my study, the bay and black horses of Carthusian backgrounds are of better quality than the bay and black horses of other ancestry. In an effort to improve the Andalusian horse, breeders should set out not with obtaining color as a goal, but to obtain quality. If color comes from that goal then they have reached the best of both worlds.

My hypothesis is fully supported in every manner as the Carthusian bred Andalusians were of better quality than non-Carthusian bred individuals. The white Carthusians were best of all, with bays following behind, and finally the blacks. Future

experiments in which color genes themselves are identified and paired with those genes unique to Carthusians and certain qualities and conformational faults would allow for a dramatic improvement in the breeding of these beautiful animals.

References

Biology Daily. 2007. Carthusian horse. The Biology Encyclopedia Online. http://www.biologydaily.com/biology/Carthusian_horse

Equiandalusian Online. 2008. http://www.equiandalusian.com/inicio.cfm

Libro Genealogico Online. 2006 Melpi, S.L. http://www.librogenealogico.com

L.I.M.P.R.E. 2000. *The Spanish Purebred Horse.* Brizzolis, S.A.

Llamas, Juan. 1997. This Is the Spanish Horse. J.A.Allen and Co., London

MELPI. Gescab 2007 Melpi, S.L. http://www.melpi.es/

Molina, Valera, Dos Santos, Rodero. 1999. Genetic Parameters of Morphological Traits in Andalusian Horse. Department of Genetic Veterinary Faculty, University of Cordoba. Livestock Production Science 60: 295-303

Royo, Alvarez, Beja-Pereira, Molina, Fernandez, Jordana, Gomez, Gutierrez, Goyache. 2005. The Origins of Iberian Horses Assessed via Mitochondrial DNA. Journal of Heredity 96(6): 663-669.

Valera, Molina, Gutierrez, Gomez, Goyache. 2005. Pedigree Analysis in the Andalusian Horse:

Population Structure, Genetic Variability and Influence of the Carthusian Strain.

Livestock Production Science 95: 57-66.

Vavra, Robert. 2004. Cardenas Horses & Home. Equivision