

Videodermoscopic analysis of the skin of Purebred Arabian horses and Polish Sports horses

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Summary

Videodermoscopy is a modern method of skin examination that significantly facilitates diagnosis. The purpose of the study was to determine and compare the characteristic features of the skin and its derivatives for Purebred Arabian and Polish Sports horses. The study was conducted in the winter of 2018/2019, with written consent obtained from the horses' owners before examinations. The study involved 33 healthy horses not previously used for breeding, consisting of 21 purebred Arabian mares and twelve clinically healthy Polish Sports horses (SP). Videodermoscopic evaluations were performed of seven selected areas of the body: the forehead, mane, neck, chest, flank, rump, and tail. For the dermoscopic examination, an Italian Video-Dermascope 7 (Medici Medical SRL with 3 VIDIX 5Mpx camera and VX1 – Contact type cap Ø 3.5 cm) was used. The Olympus cellSens specialized software was used to analyze microscopic images and perform measurements. The comparison of hair thickness showed significant differences between the two groups: in most of the assessed body areas, the hair thickness was greater for the Arabian horses than for the Polish Sports horses. The hair thickness ranged from 52.70 µm on the chest to 87.45 µm on the mane in the Arabian horses and from 30.18 µm on the flank to 47.33 µm on the rump in the SP horses. In conclusion, the breed of the horse is an important factor that must be taken into consideration in both qualitative and quantitative evaluations of the skin and its derivatives.

Keywords: videodermoscopy, Arabian horses, Polish Sports horses, horse, skin, hairs

Videodermoscopy is a modern method of skin examination that significantly facilitates diagnosis. Its big advantage is its non-invasive nature (1, 11), which makes the examination much easier. In veterinary medicine, videodermoscopy is primarily used in the diagnosis of diseases in dogs and cats, such as dermatophytosis, demodicosis, folliculitis, and diseases associated with the development of alopecia, both non-inflammatory alopecia and alopecia associated with itching (16-18, 23-25). In horses, videodermoscopy is not yet very popular; only a few publications describe it (9, 14, 18). However, due to significant miniaturization of the equipment, this method of examination is increasingly used in large animals as well.

In humans, it is commonly used, among others, to diagnose patterns of hair loss (10). So far, the gold

standard in the diagnosis of many diseases has been the histopathological examination of the skin, which, due to its invasive nature, may be difficult to perform when the disease affects the skin of the face or scalp (10). An example of such a disease is demodicosis, in which the accuracy of diagnosis with a videodermoscope is comparable to that of a biopsy (3, 18, 20), which means that it can sometimes replace a biopsy (10) or facilitate the selection of an appropriate place to perform a biopsy (20). Videodermoscopy is used in particular in places where biopsy is impossible, e.g. the edge of the eyelid (8, 26). It is increasingly used in monitoring the progress of treatment (4). Digital Videodermoscopy is a recently developed method that can visualize the hair shaft with greater resolution and greater magnification (from 20 × to 180 ×). Moreover,

trichological examination, which involves the need to pull out the hair (2, 6, 12), is increasingly replaced by this non-invasive method.

The purpose of the study was to determine and compare the characteristics of the skin and its derivatives for Purebred Arabian and Polish Sports horses.

Material and methods

We decided to select purebred Arabian horses for our research because of the uniformity of this breed. They have been kept pure bred for centuries, and Poland is one of the most important places where they are bred. The second group of horses included in the study consisted of much more diverse horses. Polish Sports horses are the most popular registered group of horses in Poland.

The study involved 33 healthy horses not previously used for breeding, consisting of 21 purebred Arabian (00) mares and twelve clinically healthy Polish Sports horses (SP). The Arabian mares were aged 3 to 21 years (median 4 years), sourced from a broodmare farm and stabled similarly. Among the 21 mares, 14 were grey, 6 were bay, and 1 was chestnut. The Polish Sports horses comprised 8 geldings aged 4 to 26 years (median 9) and 4 mares aged 10 to 20 years (15). The SP horses included 4 bay horses (2 bay geldings and 2 bay mares), 4 black horses (3 black geldings and 1 black mare), 2 chestnut horses (two geldings), one grey mare, and one palomino gelding. All animals were kept at the same riding club and maintained under similar conditions. The study was conducted in the winter of 2018/2019, with written consent obtained from the owners before examinations. All procedures were non-invasive and conducted in the stable corridor, with horses haltered and held by their handlers, none requiring sedation or other forms of restraint during examinations.

Videodermoscopic evaluations were performed of seven selected areas of the body: the forehead, mane, neck, chest, flank, rump, and tail. During the study, the thickness of primary hair and the number of hairs (density) were quantified, while pigmentation, skin colour, and visibility of hair follicle openings and capillaries were assessed qualitatively. For the dermoscopic examination, an Italian Video-Dermoscope 7 (Medici Medical SRL with 3 VIDIX 5Mpx camera and VX1 – Contact type cap Ø 3.5 cm) was used. The areas to be examined were prepared by cleaning with a brush and then applying immersion oil to the hair and skin to improve contact and image quality. The hair was combed to the sides to create a „parting” to expose the epidermis and dermis, followed by the application of the head of the videodermoscope. Photographs were taken at 30 × magnification using polarized light, all saved at high resolution (2560 px × 1920 px). The pigmentation, skin colour, and hair follicle openings and capillary visibility parameters were assessed in real-time and recorded, while other parameters, including hair thickness and density, were calculated later. Hair thickness was calculated using photos taken at 30 × magnification, with diameters of 10 randomly selected hairs measured three times at intervals equivalent to one third the length of the hair. The average of these measurements was used for further calculations. The Olympus cellSens specialized software was used to analyze

microscopic images and perform the above measurements. Identical hair thickness tests were conducted in each of the seven selected body areas. Statistically significant differences in hair thickness and density were calculated using the JASP Team (2024) software, with a value of $p \geq 0.05$ considered statistically significant.

Results and discussion

Clinical results of the videodermoscopic evaluation

Forehead. In photos taken with a videodermoscope at 30 × magnification in purebred Arabian horses, the spiral arrangement of hair follicle openings, forming a whirlwind, was much more discernible (Fig. 1). Among the 21 Arabian horses, 10 horses had light pigmented skins (9 grey and 1 chestnut). Of the 12 SP horses, only one palomino horse had no pigment on the head. In both groups, hair follicle openings were clearly visible, with a rim, i.e. a thickening of pigment

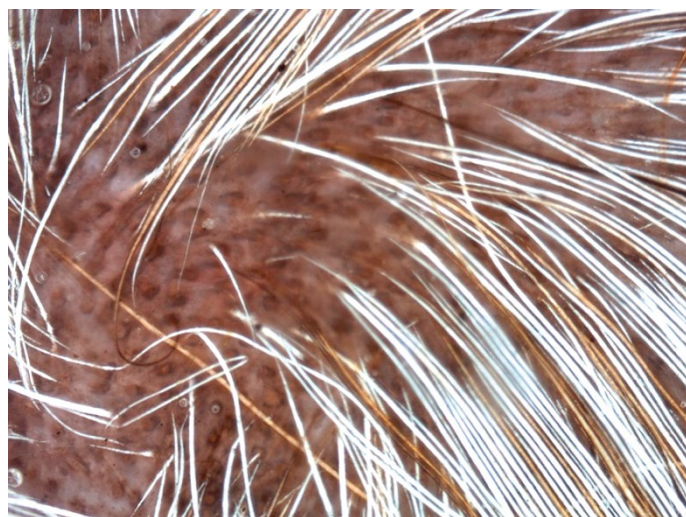


Fig. 1. Polarized dermoscopic image of the forehead area at 30 × magnification. The photo was taken in an Arabian horse. Visible spiral arrangement of hair follicle openings (whirlwind)



Fig. 2. Polarized dermoscopic image of the forehead area at 30 × magnification. The photo was taken in an SP horse. If the skin is pigmented, there is a visible pigment brightening around the rim

around hair follicle openings. If the skin was highly pigmented, we could also see a pigment brightening around the rim (Fig. 2).

Mane. In 11 of the Arabian mares, the skin of the mane was lighter than that of the other areas of the body. In horses with lighter skin, capillaries were visible (Fig. 3). Hair follicle openings in this area were visible in only 7 horses, regardless of the degree of skin pigmentation. Transparent gray hair were found in 4 of the 14 gray horses.

In 6 of the SP horses, the skin in the mane area was lighter than elsewhere. Capillaries were visible only in a few horses with lighter mane skin (6 horses), and hair follicle openings were visible, regardless of skin pigmentation, in 6 horses. In this group, the openings of sebaceous glands were visible in 4 horses (Fig. 4).

In both groups, hair follicle openings were visible, with a thickening of pigment around them surrounded with a lighter border.

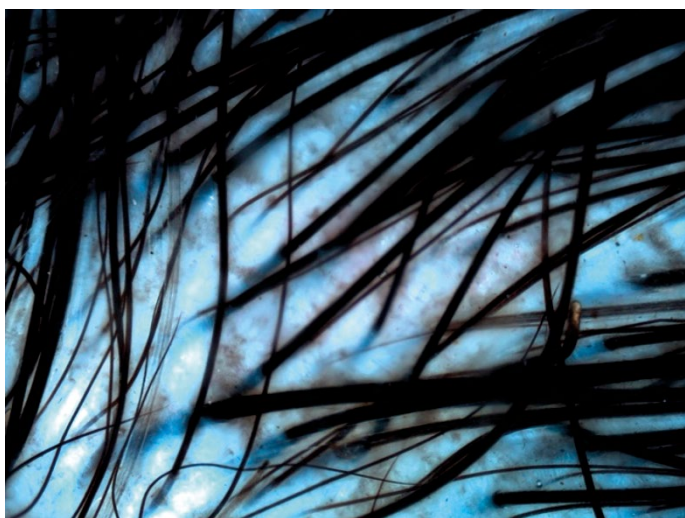


Fig. 3. Polarized dermoscopic image of the mane area at 30× magnification. The photo was taken in an Arabian horse. Hair follicle openings are visible with a thickening of pigment around them surrounded with a lighter border. Also visible are capillaries

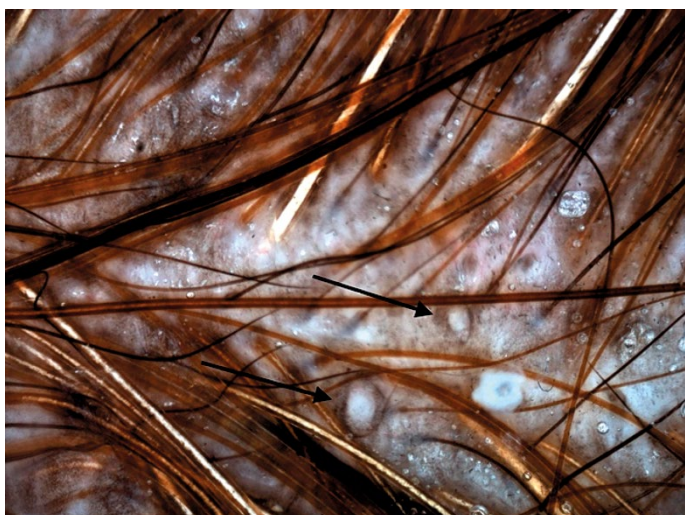


Fig. 4. Polarized dermoscopic image of the mane area at 30× magnification. The photo was taken in an SP horse. Visible sebaceous glands (arrow)

Neck. Hair follicle openings in this area were not visible in the Arabian horses. In 12 horses, the neck skin was quite light with a small amount of pigment. In 9 horses, the skin was dark, and in only one horse, it was almost black. Capillaries were visible in 14 horses.

The skin was heavily pigmented in 9 SP horses, lightly pigmented in 2 horses, and unpigmented in one horse. Hair follicle openings were visible in only 3 horses (Fig. 5). In 8 horses, capillaries were visible regardless of the degree of skin pigmentation (Fig. 6).

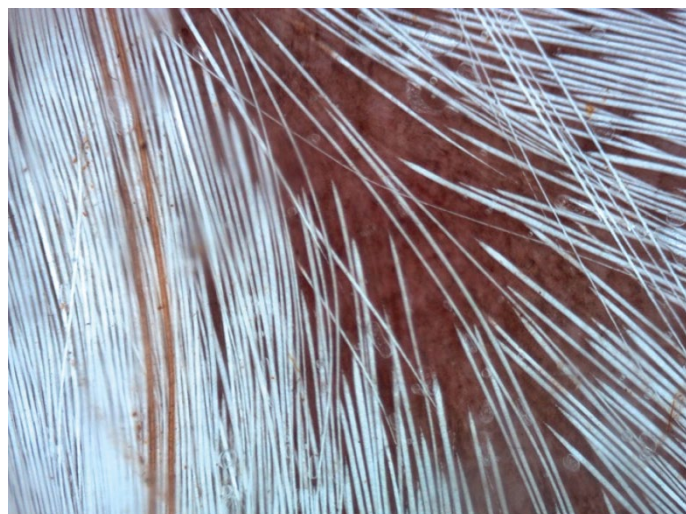


Fig. 5. Polarized dermoscopic image of the neck area at 30× magnification. The photo was taken in an Arabian horse. Follicular ostia are much less visible on the neck than they are on the forehead



Fig. 6. Polarized dermoscopic image of the neck area at 30× magnification. The photo was taken in an SP horse. Visible capillaries

Chest. In both groups, the skin was uniformly pigmented.

In 15 Arabian horses, the skin was moderately pigmented. Six horses had very light skin. In 5 mares, a leopard-like pattern was visible. Capillaries, especially those of spiral shape or U-shape, were visible in 16 horses (Fig. 7). Hair follicle openings were not visible in this area.

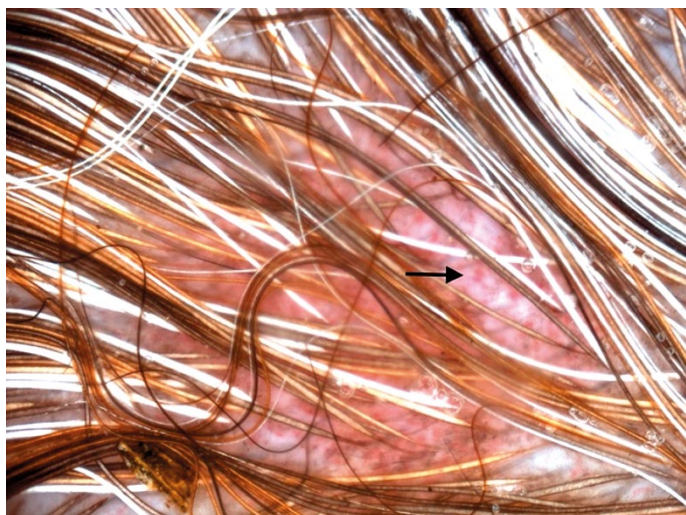


Fig. 7. Polarized dermoscopic image of the chest area at 30× magnification. The photo was taken in an Arabian horse. U-shape capillaries (arrow)



Fig. 9. Polarized dermoscopic image of the flank area at 30× magnification. The photo was taken in an SP horse. The leopard-like pattern of pigment thickening is clearly visible



Fig. 8. Polarized dermoscopic image of the chest area at 30× magnification. The photo was taken in an SP horse. Non-uniformly pigmented skin. Leopard-like pattern



Fig. 10. Polarized dermoscopic image of the flank area at 30× magnification. The photo was taken in an Arabian horse. Capillaries are clearly visible

In 11 SP horses, the skin was pigmented to varying degrees. One of those horses had black skin. Only one horse had unpigmented skin. Hair follicle openings were not visible in this area. Capillaries were visible in 6 horses, and a leopard-like pattern was present in 2 horses (Fig. 8).

Flank. Nineteen Arabian horses showed skin pigmentation to varying degrees. Eight horses had light skin, and 2 had very dark skin. Capillaries were visible in 12 horses. Hair follicle openings were visible in this area in 3 horses. A leopard-like pattern was present in 4 horses (Fig. 9).

In 11 SP horses, the skin was pigmented. Three horses exhibited a leopard-like pattern. Three horses had lightly pigmented skin, and one had almost black skin. Skin pigmentation was absent in only one horse, the palomino. Capillaries were visible in 6 horses (Fig. 10). Hair follicle openings were not visible in this area.

Rump. In 17 Arabian horses, the skin on the croup was predominantly light, with more noticeable pig-

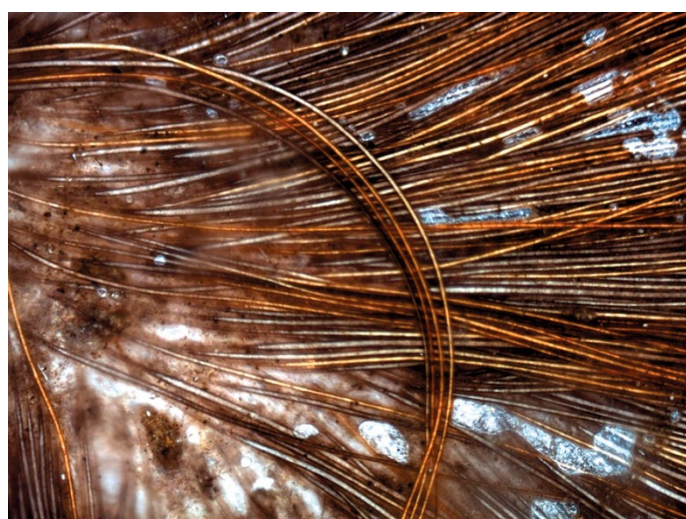


Fig. 11. Polarized dermoscopic image of the rump area at 30× magnification. The photo was taken in an Arabian horse. There are no visible hair follicle openings or capillaries

mentation in only 4 horses. There were no visible hair follicle openings or capillaries (Fig. 11).



Fig. 12. Polarized dermoscopic image of the rump area at 30× magnification. The photo was taken in an SP horse. The skin on the rump is more transparent, and sebaceous gland are visible (arrows)



Fig. 13. Polarized dermoscopic image of the tail area at 30× magnification. The photo was taken in an SP horse

In the SP group, all horses except for the palomino exhibited pigmented skin in this area. Specifically, one horse had light skin, four had moderately pigmented skin, and three had very dark skin. Additionally, a leopard-like pattern was visible in three horses. Sebaceous glands were visible in this area (Fig. 12).

Tail. In both groups, the skin was opaque, with no visible follicular or vascular outlets (Fig. 13, 14).

In the Arabian horse group, the skin on the croup was notably pigmented in 17 horses and light in 4 horses.

In the SP horses, the skin was pigmented, except for one (the palomino).

Hair thickness and density

The hair of the purebred Arabian horses was thicker in every area compared to that of the SP horses. The hair thickness in the Arabian horses ranged from 52.70 µm on the chest to 87.45 µm on the mane, whereas in the SP horses it ranged from 30.18 µm on the flank to 47.33 µm on the rump. The results are presented in Tab. 1. Statistically significant differences were found between the two groups of horses in terms of hair thickness in four areas: neck ($p = 0.006$), chest ($p = 0.0007187$), flank ($p = 0.00005019$), and rump



Fig. 14. Polarized dermoscopic image of the tail area at 30× magnification. The photo was taken in an Arabian horse

($p = 0.0002771$). In each of these areas, the hair was thicker in the Arabian horses.

The number of hairs in the Arabian horses was also significantly higher than it was in the SP horses. In terms of hair density, the number of hairs in the dermoscopic field of view ranged from 1458 on the rump to 3680 on the head for the Arabian horses and from 1106

Tab. 1. Hair thickness (diameter) measured in different areas of the skin of Polish Sports horses (SP) and Arabian horses (00) in the winter season

Forehead		Neck		Chest		Flank		Rump		Mane		Tail	
SP	00	SP	00	SP	00	Sp	00	SP	00	SP	00	SP	00
35.23 ± 8.97	58.72 ± 9.05	41.61 ± 14.26	53.01 ± 8.78	36.77 ± 11.86	52.70 ± 10.37	30.18 ± 18.53	52.85 ± 9.86	47.33 ± 13.98	60.44 ± 14.36	43.74 ± 16.23	87.45 ± 23.28	46.31 ± 18.36	71.39 ± 30.97

Tab. 2. The density of hair in the dermoscopic field of view (9.62 cm²) in different areas of the skin of Polish Sports horses (SP) and Arabian horses (00) in a winter seasons

Forehead		Neck		Chest		Flank		Rump		Mane		Tail	
SP	0	SP	00	SP	00	SP	00	SP	00	SP	00	SP	00
1446.88 ± 924.88	3680.20 ± 2349.92	1338.89 ± 1077.77	1927.20 ± 611.83	1749.83 ± 1480.66	3501.95 ± 6289.09	1438.02 ± 1857.81	2665.82 ± 1566.10	1613.02 ± 926.69	1458.36 ± 691.23	1151.56 ± 1691.36	2356.81 ± 3005.64	1106.42 ± 1491.49	1838.70 ± 2354.68

on the tail to 1749 on the chest for the Polish Sports horses. Only on the rump was the number of hair higher for the SP horses than it was for the Arabian horses: 1613 and 1458, respectively. The results are presented in Table 2. Statistically significant differences in hair density were found for the neck ($p = 0.01$) and breast ($p = 0.003$) (higher number in the Arabian horses) as well as for the rump ($p = 0.002$) (higher number in the Polish Sports horses).

This is the first study using a videodermoscope to compare two horse breeds. So far, research has been carried out on only one breed (13-15) or on a heterogeneous group of horses without considering breeds (9). Videodermoscopic examination of the skin and hair of purebred Arabian horses and Polish Sports horses made it possible to perform a detailed analysis of differences between these the two breeds. The study was conducted during the winter season, and therefore the dominant type of hair in both groups of horses was long primary hair. The results revealed significant differences in skin structure between the purebred Arabian horses and the SP horses.

The dominant coat colors in Polish Sport horses are bay and chestnut. In Polish Sport horses, skin pigmentation depends largely on the coat color. The lighter the basic coat, the lighter the skin. An example of this was the palomino horse with pigment-free skin all over its body. The chestnut colour proved to be intumescent due to the presence of both very light and very dark skin. The darkest pigmented skin was observed in bay horses, whose skin was clearly darker than even that of the black horses.

A notable feature of Arabian horses is the prevalence of grey animals. However, this color exhibits considerable diversity, which is evident in videodermoscopic images. For instance, grey hair may have a white cortex and white medulla, a transparent cortex and white medulla, or a transparent cortex and transparent medulla. Their skin may be darkly pigmented or unpigmented, regardless of the type of grey hair (14).

In both groups, the lightest skin was in the mane. This may be determined by the density or thickness of hair in that area. Additionally, the skin of the neck and chest was always more pigmented than that of the rump, probably because of the thinner and less dense hair in the neck and chest areas.

The study also showed that hair follicle openings in both groups were most visible on the head compared to the other areas of the body. In both breeds, the skin around the flank tended to be most transparent, revealing capillaries. On the tail of both breeds, the skin appeared to be thickest, and neither hair follicle openings nor capillaries were visible.

In the SP horses, sebaceous gland openings were visible on the mane and rump, which could not be seen in the Arabian horses. Other authors (19) noted the presence of sweat glands primarily on the neck. In our

study, these glands were not observed, perhaps because the area examined was too small. Additionally, in the study that showed the presence of glands, the horses were shaved immediately before the test.

The comparison of hair thickness showed significant differences between the two groups, with the hair thickness being greater in most body areas of the Arabian horses compared to the Polish Sports horses. In the group of Arabian horses, the diameter of large primary hair ranged from 52.70 μm to 87.45 μm . In the group of SP horses, the average large primary hair thickness ranged from 30.176 μm to 47.331 μm . The average hair thickness in the SP horses was also lower than 50 μm to 90 μm reported by other authors (9, 22).

In the Arabian horses, hair density in the field of view (9.6 cm^2) ranged from 1458.36 to 3680.2, which corresponds to 167 to 383 hairs per cm^2 . In the SP horses, hair density in the same field of view ranged from 1106 to 1749, which corresponds to 115 to 182 hairs per cm^2 . These values are lower than those reported by Legnani et al. (400-920 cm^2). However, these studies were performed on different horse breeds and in different seasons, which may explain the differences.

Given the differences in quantitative parameters of hair, it is important to take the breed of the horse into account when assessing hair. This is particularly important, for example, if the assessment is used to monitor treatment and evaluate the number of newly apparent hairs.

This study was performed within one season, which significantly limits the results concerning skin pigmentation. In winter, light is less intensive, and therefore skin pigmentation is less visible. Hair provides important protection against UV rays, and similar studies conducted in the summer season could evaluate the effectiveness of the barrier formed by hair.

In conclusion, the breed of the horse is an important factor that must be taken into consideration in both qualitative and quantitative evaluations of the skin and its derivatives.

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