The coat characteristic of yak maintained in conditions of the Gdańsk zoological garden

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Abstract: The coat characteristic of yak maintained in conditions of the Gdańsk zoological garden. The investigation concerned the analysis of chosen coat features of yak maintained in totally different environment than they naturally exists. The study has been carried out on all adult yak individuals (4 females and 4 males) kept in Gdańsk zoological garden. The coat samples have been taken in autumn from middle of the left side of animal to determine the proportion of hair fractions, length and fibre thickness within fraction, fibre surface features and cross section. The fractions were separated based on the length of the fibre within sample. Proportion of fraction was calculated from the fibre number within it. Fibre diameter of each fraction has been measured using microperection method. The fraction length was determined measuring fibre bunches with accuracy to 0.5 cm. The scales on the fibre surface as well as shape of cross-section were observed using scanning microscope. Two fibre fractions were determined: coarse hair (25%) and mid-type fibres (75%). The down fibres has not been found. The diameter of coarse hair and mid-type fraction averaged out 58.21 μm and 36.52 μm respectively. The coarse hair thickness in males was greater than in females (P ≤ 0.01). Fibres belonging to mid-type fraction were characterized by clear scales and more regular, circular shape. In coarse hair disappearance of scales, medullation and elliptical cross section has been recorded. The coarse hair fraction was much longer than mid-type fibres (P ≤ 0.01). There was not statistical difference in fraction length depending on sex of animals.

Key words: yak, environment, coarse hair, mid-type fibres, fibre thickness, fibre length.

INTRODUCTION

The yak (Peophagus grunniens or Bos grunniens) are found on the plateau of western China in alpine and subalpine regions, at altitudes from 2000 to 5000 m with a cold, semi-humid climate. The greatest density of the yak appears in Qinghai-Tibetan Plateau (Miller, 1990).

The population of those animals in Chinese territories is estimated to exceed 13 million. The majority of them are domesticated. As wild animals they occur in Tibetan highland. About 1-milion yaks exists in other Asiatic countries (Wiener et al., 2003). However, they are also present in North America in zoological parks and in many European countries in zoological gardens.

The yak are very good adopted to extreme environmental conditions like: very low temperature, high altitude with low oxygen content of the air, high solar radiation and cyclical nutrition with short growing season for herbage. The compact conformation, large lungs, heart and rumen relative to yak body size...
are useful to this adaptability. The most important factor derminating distribution of yak is temperature. They perform adequately when annual mean temperature is below 5°C and in the hottest months is not above 13°C. They can survive also at temperatures –40°C and below (Xu and Wu, 1984; Wiener et al., 2003).

Except compact conformation, heat conservation is effected also by coat structure (Ouyang, 1985). The coat consist three types of fibre: coarse, long hair, down fibres and mid-type fibres. The composition of the coat and hair growth change with season. As temperature falls, down fibre grow densely among corser hairs. As air temperature rises, down fibres begin shed from the fleece. In spite of that, yak are characterized by low tolerance to high temperature. It is result of poorly developed of sweat glands (Wang and Ouyang, 1984).

The finnest and most dense coat is found in calves. The proportion of down fibres declines with age (Wiener et al., 2003). In the coat structure of yak, the length of fibres is also very considerable. Long hair, especially occurent in lower parts of yak’s body, perfectly isolate them form cold, snow-covered ground.

The purpose of presented study was analysis of chosen coat features of yak maintained in totally different conditions, than they naturally exists. The fleeces of yak from Gdańsk zoological garden have been indicated.

MATERIAL AND METHODS

The study has been carried out on all adult yak individuals kept in Gdańsk zoological garden. There were 4 males, 4 females and 2 calves in the flock. The calves’ coat was excluded from analysis because of low number of animals in that group. The animal has been kept all year long on 300 m² paddock with roofed feed rack.

Green forages and tree branches fed the animals during the summer and hay in winter. Additionally, they obtained root crops and grain meal. Free acces to water and mineral licks was also provided.

The coat samples have been taken in autumn from middle of the left side of animal to determine the proportion of hair fractions, length and fibre thickness within fraction, fibre surface features and cross section.

The analysed samples had the same weight. They were divided on fractions based on the length of the fibre within sample. All fibres from each fraction were counted, what has allowed indicating their proportion in sample.

Fibre diameter of each fraction has been measured using microprojection method according to PN-72/P-04900, modified by measurement of all fibres on the slide area.

The fraction length was determinated measuring fibre bunches with accuracy to 0.5 cm.

The scales on the fibre surface as well as shape of cross-section were observed using scanning microscope (SEM) Joel type JSM 35C.

Statistical analysis of the data was performed using the SPSS 14.0 software (2003). To determine level of significance the t-Student test has been used.

RESULTS AND DISCUSSION

On the base of difference on fibre length two hair fractions were separated in investigated yak coat. The average share
of longer coarse hair was about 25%, while shorter mid-type fibre fraction 75%. Although differences did not show statistical significance, the proportion of mid-type fibres in females was 11% higher than in males (Figs 1, 2).

The diameter of coarse hair and mid-type fraction averaged out 58.21 μm and 36.52 μm respectively.

According to Xue and Yu (1981) and Wang and Ouyang (1984) fibre thickness of coarse hair is above 52.5 μm, while mid-type fibres contained between 25 μm – 52.5 μm, what was also confirmed in present study (Tab. 1). The coat of investigated yak did not contain down fibres, average thickness of which should not exceed 25 μm, but usually is at the level between 16–18 μm (Ji et al., 2001).

The lack of down fibres could testify the adaptation of these animals to different climatic conditions. It belongs to remember, that yak exhibits worse tolerance on temperature above 22°C (Li, 1985).

The coarse hair thickness in males was of 50% ($P \leq 0.01$) greater than in females (Tab. 2). Mid-type fibres did not show that large differentiation. The sex influ-

![FIGURE 1. The distribution of fibre fractions in yak females (%)](image1)

![FIGURE 2. The distribution of fibre fractions in yak males (%)](image2)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Mid-type fibre</th>
<th>Coarse hair</th>
<th>Standard error</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction proportion (%)</td>
<td>74.90</td>
<td>25.10</td>
<td>6.19</td>
<td>**</td>
</tr>
<tr>
<td>Fibre thickness (μm)</td>
<td>36.52</td>
<td>58.21</td>
<td>4.18</td>
<td>**</td>
</tr>
<tr>
<td>Variability (%)</td>
<td>40.79</td>
<td>35.77</td>
<td>2.21</td>
<td>ns</td>
</tr>
<tr>
<td>Fibre length (cm)</td>
<td>4.81</td>
<td>8.34</td>
<td>0.38</td>
<td>**</td>
</tr>
</tbody>
</table>

ns – not significant effect; *significance at $P \leq 0.05$; **significance at $P \leq 0.05$.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Females</th>
<th>Males</th>
<th>Standard error</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse hair thickness (μm)</td>
<td>46.01</td>
<td>70.41</td>
<td>4.61</td>
<td>**</td>
</tr>
<tr>
<td>Mid-type fibre thickness (μm)</td>
<td>34.58</td>
<td>38.47</td>
<td>3.04</td>
<td>ns</td>
</tr>
<tr>
<td>Coarse hair length (cm)</td>
<td>7.75</td>
<td>8.94</td>
<td>0.61</td>
<td>ns</td>
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<tr>
<td>Mid-type fibre length (cm)</td>
<td>5.00</td>
<td>4.63</td>
<td>0.44</td>
<td>ns</td>
</tr>
</tbody>
</table>

ns – not significant effect; *significance at $P \leq 0.05$; **significance at $P \leq 0.05$. 
ence on this trait has been confirmed also by Zhang (1977) and Xue and Yu (1981). The variability of fibre thickness was similar in both separated fractions. But mid-type fibres had worse equalization in comparison to coarse hair (Tab. 1). It indicates the difficulty in proper separation of fibres, what demonstrate dispersion curve of fibre thickness (Figs 3, 4). If not difference in length between fractions mid-

FIGURE 3. Variation in fibre diameter within studied fractions

FIGURE 4. Variation in fibre diameter within studied fractions
-type fibres, based only on their thickness, could be included to coarse hair as well. However, appurtenance of fibres to mid-type fraction was verified by analysis of fibres surface and their cross section. Fibres belonging to that fraction were characterized by clear, regular scales, occurrent on whole its length. While the surface image of coarse hair showed unclear acutance and disappearance of scales (Phot. 1, 2). It is in accordance with Wang (1984), which considered that the angle between scale and hair shaft in yak is very small so that scale virtually sticks to the shaft, what gives poor felting qualities of yak hair.

The analysis of cross section of investigated fractions indicates more regular, circular shape of mid-type fibres and elliptical of coarse hair. The presence of medulla was stated also only in coarse hair fraction (Phot. 3, 4). The occurrence of medullation in thickest fibres was confirmed by Wang (1984) in investigations on the ultramicroscopic structure of the yak coat.
The coarse hair fraction was about 57% longer than mid-type fibres \((P \leq 0.01)\), (Tab. 1). There was not statistical difference in fraction length depending on sex of animals (Tab. 2).

The differences in hair length are mainly related to fibre type and body parts. According to Zhang (1989) the length of coarse hair varying from 8.9 cm to 21.1 cm and mid-type fibres from 5.3 to 13 cm, with the longest in both cases on the belly and the shortest on the shoulder. The similar dependences concern down fraction also, but it has not been found of studied yak coat.

**CONCLUSIONS**

1. In the coat of yak maintained in Gdańsk zoological garden the coarse hair (25%) and mid-type fibre (75%) fractions has been separate. The occurrence of down fraction has not been stated.

2. The average thickness of coarse hair fraction reached 58.21 µm, while mid-type fibres 36.52 µm. Coarse hair fraction was significantly thicker in males. The diameter of mid-type fibre was similar in both sexes.

3. The appurtenance to coarse or mid-type fraction was confirmed by surface and cross section analysis of fibres. Coarse hair showed medullation and disappearance of scales.

4. The coarse hair were almost twice as much longer than mid-type fibres.

**REFERENCES**


NORMA PN-72/P-04900, Metody badań surowców włókienniczych. Wełna.


**Streszczenie:** Charakterystyka okrywy włosowej jaków utrzymywanych w warunkach gdańskiego ogrodu zoologicznego. Badania dotyczyły analiz wybranych cech okrywy włosowej jaków utrzymywanych w środowisku zupełnie odmiennym od naturalnych warunków ich bytowania. Badaniami objęto wszystkie osobniki dorosłe (4 samice i 4 samece) stada jaków utrzymywanych w gdańskim ZOO. Próby okrywy pobrano jesienią ze środka boku. Posłużyły one do określenia udziału frakcji włosów, grubości i długości...
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