Video Aided Measurement Method for Characterization of Phenotypical Traits of an Indigenous Cattle Breed

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This study aims to identify phenotypical traits of the Hungarian Grey (HG) and two more podolic breed (Maremmana, Anatolian Grey) with the Video Aided Measurement (VAM) method. The sample has been gathered from 1090 Hungarian Grey out of five herd and 26, and 30 from the Maremmana and Anatolian Grey.

The measurements have been done by taking relevant pictures from videos recorded through the optometric VAM method. As the animal stands still in pictures, the measurements obtained via this method are safer, practical and reliable.

The standard deviations and the average body size of Hungarian Grey cattle examined by this method were found to be: height at withers 133,0 cm (sd:5,7); height of back 131,5 cm (sd:5,7); rump height 133,7 cm (sd:6,1) trunk length 157,6 cm (sd:9,7); chest depth 76,9 cm (sd:4,3); body length 152,6 cm (sd:10,6); width of chest 45,5 cm (sd:4,3). The discriminant function analysis of intra- (Hungarian) and inter-breed dataset showed that there were statistically significant phenotypical differences among the herd.

Based on the results, the VAM method can be a potential tool for conservation herds, primarily for obtaining the data of phenotypical aspects. New approaches like geometric morphometry can also be used for gaining phenotype data.

Keywords: phenotype, Hungarian Grey Cattle, Maremmana, Anatolian Grey, body measurements, optometry, archives

Yerli Bir Sığır Irkının Fenotipik Özelliklerinin Tanımlanmasında Video Yardımlı Ölçme Yönteminin Kullanılması

Bu çalışmada amaç Hungarian Grey ile iki podolik ırkı olan Maremmana ve Boz Step (Anatolian Grey) sığır ırklarında, Video Destekli Ölçüm (VAM) yöntemiyle fenotipik bazı özelliklerin belirlenmesidir. Bu bağlamda Hungarian Grey sığır ırkından 5 sürüden 1090 birey ile Maremmana ve Boz Step ırklarından sırasıyla 26 ve 30 bireylik örneklerde çalışılmıştır.

Optimetrik VAM yöntemi ile kaydedilen videolardan uygun resimler alınarak ölçümler yapılmıştır. Çünkü resimde hayvan sabit duruduğu için bu metotla elde edilen ölçümler daha hızlı, pratik ve güvenilirdir.

Bu metotla incelenen Hungarian Grey sığır ırkındaki vücut ölçüleri ortalama ve standart sapmaları sırsıyla; cidago yüksekliği 133±5.7, sırt yüksekliği sağrı yüksekliği, gövde uzunluğu, göğüs derinliği ve vücut uzunluğu olarak bulunmuştur. Yapılan diskriminant analiz sonucunda sürü içerisinde istatistik olarak önemli fenotipik farklılıklar olduğu görülmüştür.

Elde edilen sonuçlara gore VAM metodu koruma sürüleri başta olmak üzere fenotipik verilerin elde edilmesinde bir araç olarak kullanılabilir. Geometrik morfometri gibi yeni yaklaşımlar da fenotipik verilerin elde edilmesinde kullanılabilir.

Anahtar Kelimeler: fenotip, Hungarian Grey, Maremmana, Boz Step (Anatolian Grey), vücut ölçüleri, optometri, arşivler

Introduction

The phenotypical characterisation besides monitoring the genetic diversity of endangered breeds is an important task of conservation management.

The autochthonous beef breeds are frequently kept in extensive technology. Taking of body measurements as one of the most important part of phenotype in these populations with the classical methods (e.g.: stick, tape) due to the often lower level of domestication, and sometimes dangerous horn conformation is not safe. The optometric Video Aided Measurement (VAM) method calculates the measurements from the captured still pictures of recorded video and can be a safer, practical and faster way of measuring because the animal stands still in pictures. The other aspect of the VAM method is archiving, because the video records and the pictures of the animals from two perspectives will not be only "by-products" in the future.

In our work, as a case study, the body measurements of three podolic beef breeds were measured and compared. All groups or herds of the breeds are in extensive keeping, and were not measured before. The three podolic breeds have been kept in semi wild, open-pasturing system in Hungary, Italy and Turkey for centuries.

Materials and Methods

In the indigenous Hungarian Grey breed, the last comprehensive measuring was made in 1965 with stick and tape (Bodó, 2002). Nowadays, after the bottleneck of 1960's, the breed status is not more endangered and parallel to the preservation work, the commercial selection for beef production has started. In this study, data of 1090 cows from the HG herd of Hortobágy, Bugac, Tiszaigar, Apaj, Sarród were analyzed. These herds – and especially the Hortobágy herd – are the breeding centres of these cattle. The Hortobágy herd (n=1090) of 1960's was the founder of the surviving HG population.

The autochthonous Maremmana beef breed of Italy is phenotypically very similar to the HG. The selection for beef producing was continuous, and accordingly some body measurements of breeding animals were recorded. The Torre Mancina stock is one of the nucleus stock of the breed (n=26).

The Anatolian Grey is autochthonous, small frame cattle breed of Turkey. It is in critical status and only a small nucleus has been involved in the Turkish Gene Preservation programme at Bandirma Gene Preservation Station (n=30).

Cows older than two years were measured in all herds.

A computerised optometric method was developed based on video recordings (Lehman, 1909, Mészáros, 1977, Bodó, 1988, Tőzsér, 2000), which are able to measure the animals on the captured still pictures (Maróti-Agóts, 2001). The Video Aided Measurement (VAM) method was tested for the methodical errors, and it has been developed more precise (Zehender et al. 1996; Bianconi et al 1999, 2005) than the classical methods (Maróti-Agóts et al. 2005a). The VAM measures are exchangeable to the classical measures with correlation functions (Maróti-Agóts et al. 2005b).

The optometric VAM method enables recording approximately one hundred animals per hour if the leading of animal is continuous at the recording scene. The recording scene is one 4-4,5m long straight part of the pen, which is not covered from the side of the camera, and the bars of the pen are thin or substituted with rope. The measurements were taken using the pictures of the digital video recording by two digital cameras from different perspectives. For the elimination of perspectivical error, the distances from the axis of animals from side were over than 12 meter and from above higher than 4,5 meter. The video records were made following the VAM protocol at both scenes as well (Maróti-Agóts 2001). The setup of cameras has taken approximately one hour in each case. We used our software (VAMp 1.0) for the calculation of the body measurements on the basis of marked anatomical points on the screen from two perspectives. The output, comma separated (.css) file of this software contains the measures in centimetre. The statistical analysis was performed by SPSS 12.0 for Windows software. For comparison of datasets, the variance and discriminant function analysis were used.

Results

The means and variances of the body measurements were calculated for all the measured cows and for the herds separately (Table 1).

Discussion

The phenotypical differences among Anatolian Grey and the two European podolic breed were well visible at the beginning. The harsh climatic and grazing conditions and the lack of classical, organised breeding selection resulted in smaller frame and less productivity. The differences between Hungarian Grey and Maremmana breed are not well expressed. In the Italian breed the selection work for higher meat production has been continuous from the beginning of the last century. Both body measurements are higher than in the Hungarian Grey and the body proportions are different. The body is longer and accordingly the top-line is softer than in Hungarian Grey Breed. These changes show a greater capacity of meat production in Maremanna Breed. The discriminant function analysis showed that the height at withers and the trunk length have the main factor in discrimination of herds.

The intra-breed statistical analysis of HG has shown that the body measurements of Tiszaigar and Bugac herds are over the mean of the breed (significances were not calculated due to the different variances of datasets). The reason of this difference could be explained not only by environmental factors but also by the fact that the "preserving" selection (which preserves all the phenotypes of all extremities) was not always used consequently. The high level of variance in Sarród herd shows the signs of unbalanced stock of various origins.

The measurements of Hortobágy herd are very close to the total mean, and with the high level of variance, presumably it shows the success of preserving selection.

76.4% of the cows proved to be classified as correctly grouped into breeds by discriminant functions. With the two-dimensional canonical discriminant function plot of the distribution of the individuals by herds, the distances and correlations between the herd means (centroids) and the variances were clearly defined and represented.

As a trial the body measures of HG from the last century were compared to the converted-to-classical VAM measures. The height at withers was in 1876 (Tormay) 151 cm, in 1906: 133 cm (Tormay, 1906), in 1941: 132-137 cm (Magyari, 1941) in 1968: 138 cm (Bodó, 1973), and the converted VAM measure was 131.5 cm.

Discussion

Based on these results, the efficiency of the preservation programme of the HG following the serious bottleneck is calculable on the level of phenotype.

Nowadays the success of conservation programmes of farm animal breeds is measured predominantly on molecular level. This may stem from the fast and precise methods and results.

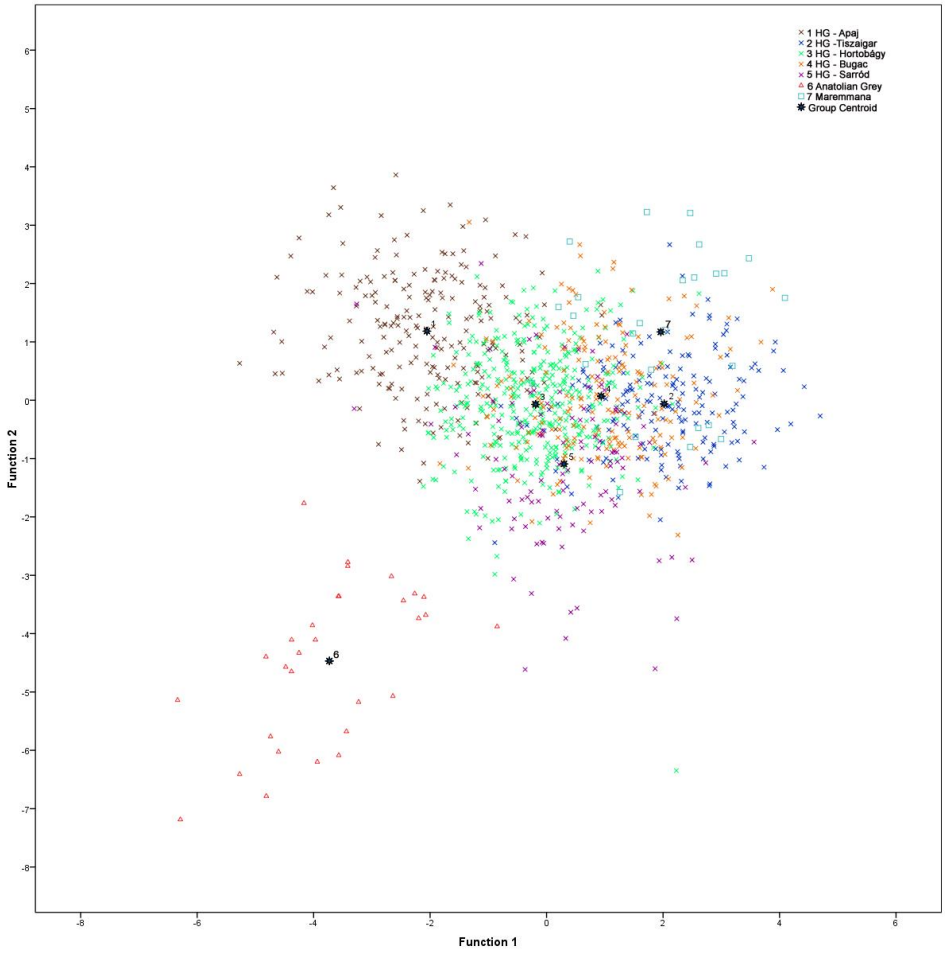
The phenotypical aspects of conservation need easy-to-use methods, and the VAM method could be an alternative and a potential tool for this task.

It should be mentioned that the measuring of the classical body measurements is not the only possible process based on the visual information of VAM method. Majority of the details are wasted by the classical one-dimensional measurement. The geometric morphometry – as a potential tool for animal breeding – and phenotype conservation is working with two dimensional shapes and the recognition of possible changes and differences in phenotype are more detailed as it was before.

Table 1. The body measurements of Hungarian Grey cows by herds and summarised in cm

breed	farm	n	Height at withers (sd)	Height of back	Rump height	Trunk length	Chest depth	Body length	Width of chest	Ischium width of the rump
Hungarian Grey	Apaj	213	133(5.6)	134(6.6)	137(7.0)	148(7.8)	79(3,7)	142(8.0)	44(3.6)	20(2.5)
	Tiszaigar	178	138(4.7)	133(4.7)	134(4.7)	165(9.1)	77(3.3)	162(9.1)	48(3.7)	22(3.4)
	Hortobágy	394	130(4.4)	129(4.6)	131(4.1)	157(6.9)	76(3.5)	151(6.9)	45(3.2)	28(3.3)
	Bugac	192	133(5.0)	130(5.2)	131(5.9)	163(8.8)	78(3.7)	160(8.6)	44(5.9)	20(3.1)
	Sarród	113	133(5.8)	132(5.9)	136(6.5)	154(8.7)	71(4.8)	147(8.8)	47(4.3)	24(3.0)
	total	**1090**	**133(5.7)**	**131(5.8)**	**133(6.1)**	**157(9.8)**	**76(4.3)**	**152(10.7)**	**45(4.3)**	**24(4.6)**
Maremanna	Torre Mancina	26	141(4.2)	135(3.3)	139(3.6)	170(10.1)	81(5.1)	167(10.6)	50(3.9)	31(2.4)
Anatolian Grey	Bandirma	30	110(7.2)	111(7.0)	114(8.5)	119(13.1)	60(4.7)	116(12.9)	32(5.9)	17(3.8)

Figure 1. Two dimensional canonical discriminant function plot for the distribution of each cow by herds within the discriminant function space according to the values for the discriminant scores of first and second discriminant function.



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