Technical note

Sheep–goat hybrid born under natural conditions

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Abstract

The paper reports a 5 year old male sheep–goat interspecific hybrid born under natural conditions. The hybrid was castrated at 10 months of age. Karyotype analysis confirmed that the animal was a male and a hybrid with 57 chromosomes, an intermediate number between sheep (2n=54) and goat (2n=60). Morphological characteristics of the animal were compared with those of castrated male Tswana goats of the same age. Data on castrated male Tswana sheep of the same age are not available. The hybrid at 5 years of age weighed 93 kg compared to 53.73±13.83 kg, the average weight of castrated Tswana male goats of the same age. The paper also raises a question of whether the animal could be of commercial interest in meat production in Botswana.

Keywords: Interspecific; Hybrid; Nuclear transfer; Goat; Sheep; Cloning

1. Introduction

Sheep (Ovis aries, 2n=54) and goats (Capra hircus, 2n=60) belong to the family Bovidae and order Artiodactyla. The two species, together with aoudads (Ammotragus) and bharals (Pseudois) are the most closely related in subfamily Caprinae (Bunch, 1978). Sheep and goats are genetically and taxonomically different and do not readily interbreed. However, occasionally the isolating mechanisms, that is biological properties of individuals which prevent the interbreeding of populations that are actually or potentially sympatric (Mayr, 1969), breakdown and permit the crossing of different but closely related species, resulting in an interspecific hybrid.

Interspecific hybridization in mammals occurs rarely in nature (Gray, 1972). The Equidae family (horses, donkeys and zebras) has the most viable hybrids even though the family has wide chromosomal differences among species (Jainudeen and Hafez, 1993). The technique of interspecific hybridization is commonly used in plant breeding to develop new cultivated species with desirable characteristics from two or more existing species, for example, tricale (Triticosecale) is a cultivated species developed from the hybridization of wheat (Triticum) and rye (Secale) (Fehr, 1993). This communication reports a 5 year old sheep–goat hybrid born under natural conditions.
2. Materials and methods

2.1. Sheep–goat hybrid

One of the authors (K.K.) reported a male animal born under natural conditions in his own herd, which he suspected was sheep–goat hybrid (Fig. 1). He reported that the dam was a goat and the sire must have been a ram, both of indigenous Tswana breeds. The hybrid was born in October 1993, and it was raised under Botswana traditional farming management system, characterized by little or no supplementary feeding and low veterinary input. The animals are housed or enclosed in a kraal at night, either from fear of predation or theft and for the need to supervise the animals by herders. Sheep and goats are usually enclosed together; there is therefore a possibility of interspecific mating. Under the farmer’s management system, both kids and lambs are castrated at 10 months of age and so was the hybrid.

2.2. Karyotyping

Karyotyping was carried out using a modified method of Bhatia and Shanker (1996). Metaphase chromosome spreads were prepared through 72 h cultures from 0.5 ml of heparinized whole blood in 10 ml cell culture medium M150 (Highveld Biological (PTY), Lyndhurst, South Africa). The medium was supplemented with 2 ml fetal calf serum (Highveld Biological) and 0.1 ml Concanavalin A (0.1% v/v) (Boehringer Mannheim, Randburg, South Africa). The slides were stained in Giemsa-phosphate-buffered solutions. About 20 metaphase chromosome spreads were examined. Photomicrographs of well-spread chromosomes were taken for karyotyping.

2.3. Morphological characterization

The linear body measurements of the hybrid were determined, including heart girth, height at withers, height at the rump and length of tail. Type of tail, tail carriage, coat cover and the weight of the animal were also recorded. The data were compared with that of castrated males of indigenous goats (>4 years of age) and of sheep 3.5–4 years of age (data on castrated males of sheep of the same age are not available).

3. Results

3.1. Karyotype of the hybrid

Fig. 2 shows the karyotype of the sheep–goat hybrid determined by Giemsa staining. The chromosomes were arranged according to size for easier identifica-
Fig. 2. Sheep–goat hybrid karyotype determined by standard Giemsa staining (2n=57).

Table 1
Body measurements of sheep–goat hybrid compared with data from castrated male sheep and goats (3.5–4 years) and castrated male goats (>4 years): ± S.D.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Castrated male goats</th>
<th>Castrated male sheep</th>
<th>Castrated male goats</th>
<th>Sheep–goat hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5–4</td>
<td>65.17±2.38</td>
<td>64.71±4.51</td>
<td>68.33±10.26</td>
<td>83.00</td>
</tr>
<tr>
<td>Trunk length (cm)</td>
<td>16.48±4.35</td>
<td>17.57±6.45</td>
<td>20.00±3.46</td>
<td>30.00</td>
</tr>
<tr>
<td>Rump length (cm)</td>
<td>69.61±3.90</td>
<td>66.14±3.93</td>
<td>74.50±3.97</td>
<td>91.00</td>
</tr>
<tr>
<td>Heart girth (cm)</td>
<td>67.94±4.60</td>
<td>64.00±4.70</td>
<td>73.17±0.76</td>
<td>90.00</td>
</tr>
<tr>
<td>Height at withers (cm)</td>
<td>80.17±5.90</td>
<td>78.71±2.21</td>
<td>87.00±7.55</td>
<td>112.00</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>40.45±8.80</td>
<td>–</td>
<td>52.73±13.83</td>
<td>93.30</td>
</tr>
</tbody>
</table>

Data from Owen and Norman (1976).
tion. All the cells that were observed showed that the karyotype was an intermediate between sheep and goat with 57 chromosomes, comprising 27 chromosomes from the sheep (sire) and 30 chromosomes from the goat (dam). The sheep genome is comprised of three unpaired biarmed autosomes, 23 acrocentric autosomes and a minute Y-chromosome (Y) that could not be determined if it was acrocentric or biarmed. The goat genome is comprised of 29 acrocentric autosomes and a large acrocentric X-chromosome (X). The karyotype showed that the hybrid was a male.

3.2. Morphological characteristics

The comparison of the body weight and linear body dimensions of the hybrid (5 years of age) and castrated males of indigenous Tswana goats (>4 years old) (Owen and Norman, 1976) (Table 1) clearly indicate that the hybrid is bigger than goats around the same age. Other physical features are compared in Table 2. The body conformation of the hybrid was more similar to that of a sheep than that of a goat (Fig. 1).

4. Discussion

4.1. Karyotype of the hybrid

The chromosome analysis confirmed that the animal was a male and indeed a hybrid with intermediate number of chromosomes (2n=57, XY) between sheep and goats. The number of chromosomes is the same as that of hybrid fetuses between bharal (Pseudois, 2n=54) and goat (2n=60) (Bunch, 1978) and sheep–goat hybrid (Pinheiro et al., 1989). The fundamental karyotype of the superfamily Bovidae contains 58 acrocentric autosomes (Wurster and Benirschke, 1968 cited by Bunch, 1978). The goats (Capra) have maintained the basic karyotype (2n=60), while in sheep (Ovis) chromosome rearrangements through a series of fusions resulted in populations of sheep with karyotypes of 52–54 (Bunch et al., 1977). These include domestic sheep (O. aries, 2n=54) (Bunch, 1978).

4.2. Morphological characteristics

The hybrid in terms of body weight and dimensions was bigger than indigenous Tswana goats and sheep. Although, the weight of castrated male sheep was not available, according to Owen and Norman (1976), castrated male goats and sheep tend to have similar weights. Tswana sheep and goats are classified as medium size breeds using classification criteria suggested by Devendra and McLeroy (1988). By virtue of its weight and body dimensions, the hybrid was comparable to large breeds of goats, such as Jamnapari of India, where there have been reports of 68–90 kg males (Devendra and McLeroy, 1988). Sheep and goats are kept as source of protein (meat, milk) and quick cash incomes in developing countries. Due to their small size compared to cattle, they are slaughtered more frequently to provide meat for home consumption with little or no need for refrigeration. Their adaptive features, such as feeding behavior, and disease and heat tolerance enable them to effectively cope with the stressful nature of the vast marginal lands of semi-arid countries such as Botswana (Katon-gole et al., 1996). Therefore, their role in food security in developing countries cannot be overemphasized. Causes of variation on adult body weight are numerous, and include nutrition and genotype-environment interaction. Although, the hybrid was raised under Botswana traditional management system characterized by low nutrition, its large size encourages speculation about the possibility of cloning this animal using nuclear transfer technology for increased meat production.

4.3. Cloning the hybrid by nuclear transfer technology

The recent production of live mammalian offspring (Wilmut et al., 1997; Kato et al., 1998; Wakayama et al., 1998) using nuclear transfer technology, offers
an alternative way of reproducing animals of interest. Most interspecific hybrids are sterile, therefore, nuclear transfer technology may offer a way of reproducing such animals. Reproducing this animal by nuclear transfer technology, may not have any significance on meat production in Botswana. Interspecific hybrids have, however, been of scientific interest in studies of linkage, gene expression, maternal inheritance, cytogenetics and for study of development and fertility (West et al., 1978).

According to McDonald (1989), the germ cells of hybrids proceed through mitosis, but there is a block to meiosis, because pairing of homologous chromosomes is impossible as a result of uneven number of chromosome numbers. Since the hybrid was castrated at 10 months of age, it was not possible to assess if it produced viable gametes. Successful nuclear transfer has been reported in a range of species including cattle, sheep, pigs, rabbits and mice (Heymann and Renard, 1996 cited by Campbell and Wilmut, 1997). Currently, producing animals using nuclear transfer technology may not be economic for developing countries, because of the cost of the technology and lack of relevant expertise. However, the technology opens a door for collaboration between developed and developing countries.

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References