Turk J Vet Anim Sci
26 (2002) 1087-1092

Research Article

Morphological Defects in Turkey Semen

Serhat ALKAN, Alper BARAN, Ö. Banu ÖZDAŞ, Mithat EVECEN
Department of Reproduction and Artificial Insemination, Faculty of Veterinary Medicine, İstanbul University, 34851, İstanbul-TURKEY

Received: 25.07.2001

Abstract: The goal of this study was to evaluate the abnormal spermatozoa rates and types of American Bronze turkeys under Turkish conditions. Semen was collected from toms by abdominal massage and pooled once a week for 10 weeks. After pooling, the semen samples were examined morphologically and mean abnormal rates and types were evaluated. A total abnormal spermatozoa rate of 17 ± 0.06% was determined. Acrosome and mid-piece defects were the leading defects at 66 ± 0.36%. Tail defects of 22 ± 0.18% and head defects of 11 ± 0.11% were the next most prevalent.

In conclusion, we observed that the most common morphological defects were at the acrosome and the mid-piece, and these organelles were the most sensitive to various environmental conditions.

Key Words: Turkey, spermatozoa, morphology, defect

Hindi Spermasında Morfolojik Bozukluklar

Özet: Çalışmada, ülkemizde bulunan Amerikan Bronzu erkek hindilerin spermatolojik özelliklerinden olan morfolojik bozuklukların tip ve oranlarını ortaya koymak amaçlanmıştır. Erkek hindilerden abdominal masaj yöntemiyle 10 hafta boyunca haftada 1 kez sperma alınmıştır. Pooling yapılan sperma örneklerine morfolojik muayene yapılarak bozukluk oranları yüzdesi ve bozukluk tipleri değerlendirilmiştir. Yapılan muayene sonucunda hindi spermasında toplam %17 ± 0.06 morfolojik bozukluk tespit edilmiştir. Gözlenen toplam morfolojik bozukluk tipleri arasında, akrozom ve orta-kısım bozuklukları %66 ± 0.36.ile başta gelen bozukluk tipi olmuştur. Bunu %22 ± 0.18 ile kuyruk ve %11 ± 0.11 ile başa ait bozukluklar takip etmiştir.

Sonuç olarak, hindi spermasında rastlanan morfolojik bozukluk tipleri arasında en sık rastlanan morfolojik bozuklukların akrozom ve orta kısımda belirlendiği ve bu organellerin farklı çevre koşullarına karşı hassasiyet gösterdiği kanısına varılmıştır.

Anahtar Sözcükler: Hindi, spermatozoa, morfoloji, bozukluk

Introduction

Artificial insemination is one of the most effective and widely used techniques for the genetic improvement of farm animals. Artificial insemination is employed on breeder farms to maintain the maximum use of males, as well as ensure disease prevention, high fertility rates and for economic reasons. Artificial insemination is also carried out when natural mating is impossible in genetically improved animals due to body size (1).

Recently, turkey breeding is gaining importance worldwide thanks to the superior feed conversion qualities of turkeys and the nutritional characteristics of turkey meat. Genetic selections for broad breasted turkeys created an obstacle to natural mating. Therefore, artificial insemination has become a necessity, especially for breeder turkey companies. For good results in the artificial insemination of turkeys, the quality of semen and a successful injection of semen into the female genital tract have to be ensured. A scientific determination of the fertilizing ability of the semen can be made by motility, live-dead and morphological examinations, and this is called potential fertility. In addition to hereditary traits, live-weight and semen collection techniques are known to affect semen quality. Therefore, spermatological characteristics are evaluated in semen to be inseminated. There exists limited literature concerning spermatozoon morphology and types in turkeys. All the studies obtained concerned either total morphological defect rates or did not include morphologic subjects at all (2-12).

The success of artificial insemination is directly dependent on the quality of the collected semen. The quality of semen is affected by numerous factors. Spermatological evaluation is essential before artificial insemination. Nowadays, for economic purposes and

administration ease, it is unavoidable to assess the potential fertility of semen prior to insemination. Spermatological tests which evaluate the motility, live-dead, abnormal spermatozoa rate and concentration of semen samples are employed for this purpose. Relating the results of these tests, a scientific consideration about the fertility potential of the semen could be performed (3).

Seminal characteristics are affected by various factors, the most important of which are live weight and semen collection technique. There is a significant positive correlation between body weight and seminal volume, pH, and abnormal spermatozoa rate, whereas there exists a negative correlation between body weight and motility, spermatozoon concentration and live spermatozoon rate in poultry (8). It is reported that a semen collector can affect semen quality while milking and it is also advised that every breeder male should be stimulated to semen collection according to its nature by applying appropriate pressure to the genitalia so as to avoid contamination with faeces, urine and blood (4).

The morphological structure of turkey semen is quite different from that of mammals. The turkey spermatozoon is long, cylindrical and sharp at both ends. Like other species, the spermatozoon is composed of the acrosome, head, mid-piece and tail. It is 0.5 µm at its widest point. The acrosome is 2 µm, the head is 13 µm, the mid-piece is 4 µm and the tail is 85 µm long (5).

It is very important to know the proportion of defective (abnormal) spermatozoa in a semen sample to determine fertility.

Ilgaz (6), who has studied the semen of American Bronze turkeys, reported a mean 6.17 ± 1.47% of abnormal spermatozoon.

Tsukunaga (11) examined the spermatozoon morphology of poultry semen and pointed out that the mid-piece is considerably longer than that of other species, approximately one quarter of the head's length and this property makes poultry spermatozoa have more mid-piece bendings than other species. This researcher classified the morphological defect types of semen assessed in vitro as follows:

1- Neck bending (mid-piece bending).

2- Mid-piece damage.

3- Acrosome damage.

   a- Bending

   b- Swelling

   c- Knotting or rounding

4- Whole head swelling.

5- Tail defects.

Sevinç et al. (10) determined a 5.44 ± 0.95% morphological defect rate in Leghorn cocks and a 6.76 ± 0.95% in New Hampshire cocks, and reported that spermatological characteristics are affected among individuals and races by various factors.

In another study by Sevinç et al. (9) abnormal spermatozoon types were classified as acrosome, head, mid-piece and tail defects. The reported rates for these criteria were 6.81%, 60.2%, 26.98% and 6.01% in Leghorn cocks and 0.37%, 4.98%, 1.69% and 3.17% in New Hampshire cocks, respectively.

Maeda et al. (7) stated that the acrosome and the mid-piece are the most sensitive parts of poultry semen to freezing, storage and thawing procedures. They also suggested that high acrosome damage could be attributed to osmotic pressure and the components of diluents.

The aim of our study was to determine and classify the morphological defect types and rates of American Bronze turkey semen under Turkish conditions. As season, environment, management and individual factors directly affect seminal morphology, thanks to this study and classification, the typing of turkey semen under Turkish environmental and seasonal conditions was performed and a reference to future studies on this subject was provided.

Materials and Methods

American Bronze male turkeys in the Department of Reproduction and Artificial Insemination of the Veterinary Faculty, İstanbul University were used in this study. The turkeys were kept together in a 4 x 4 m box located in the livestock section of the department. The temperature was between 15 and 25 ºC, humidity varied between 50 and 70% during the study and no additional light was supplied throughout the breeding season. All turkeys were between 10 and 15 kg and all were 1 years of age. The turkeys were fed ad libitum with a specially prepared breeder turkey ration containing a minimum of 28% raw

protein, maximum 2800 kcal/kg energy, as well as supplemental minerals and vitamins. Water was also available ad libitum during the study.

Semen was collected by abdominal massage and pooled once a week for 10 weeks (13,14). A drop of fresh semen from each pooling was fixed in 1 ml Hancock solution (15). A phase-contrast microscope with immersion was used for morphological examinations. At each preparation 333 cells were counted and the percentage of defect types calculated. The morphological examination results were classified as total morphologic defects, acrosome, head, mid-piece and tail defects.

Results

The morphological examination results of the study are presented in Table 1.

Table 1. Abnormal morphology rates in fresh semen (n = 10).

Acrosome (%) $\bar{x} \pm s$	Head (%) $\bar{x} \pm s$	Mid-piece (%) $\bar{x} \pm s$	Tail (%) $\bar{x} \pm s$	Total (%) $\bar{x} \pm s$
41 ± 0.24	11 ± 0.11	25 ± 0.12	22 ± 0.18	17 ± 0.06

The mean morphological defect rate of all ejaculates was 17 ± 0.06%, and the acrosome defect rate was the highest at 41 ± 0.24% (Table 1). The most frequent defect types of the acrosome were acrosome detachment (Figure 1a), acrosome swelling (Figure 1b) and comma-shaped acrosome (Figure 1c).

Total head abnormality was 11 ± 0.11% (Table 1) and the most commonly observed head abnormalities were knotted head (Figure 2a), smaller or larger head (Figure 2b), 90° or 180° bent head (Figure 2c), head swelling (Figure 2d), bending or knotting at head-mid-piece border (Figure 2e), and head detachment (Figure 2f).

Mid-piece abnormalities were the second most common defect after acrosome abnormalities at 25 ± 0.12% (Table 1). The most common abnormal mid-piece types were mid-piece swelling (Figure 3a), mid-piece bending (crooked neck; Figure 3b), mid-piece partial detachment (Figure 3c), mid-piece thickening (Figure 3d), mid-piece vacuolisation (Figure 3e), and mid-piece detachment (Figure 3f).

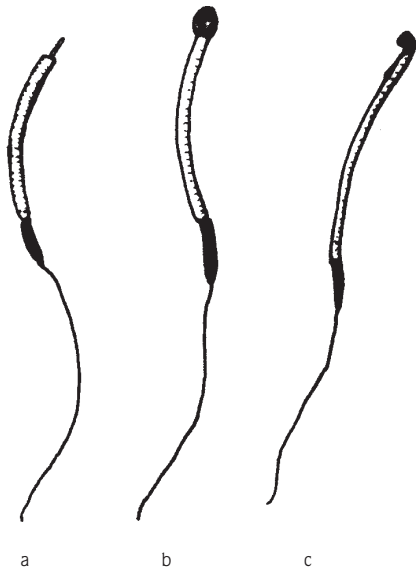

Figure 1. Acrosome Defect Types.
a) Acrosome detachment
b) Acrosome swelling
c) Comma shaped

Tail defects were 22 ± 0.18% of the total (Table 1). The most common defects were detached tail (Figure 4a), 90° bent tail (Figure 4b), 180° bent tail (Figure 4c), curled tail (Figure 4d), and tail knotting (Figure 4e).

Discussion

The morphological defects observed in turkey semen were similar to the morphologic defect types of fowl semen (1,16). Similar findings were also reported by other studies (9,17).

It was observed in the present study that, bent head or crooked neck spermatozoa were a considerable proportion of the total. Tsukunaga (11) reported similar results and attributed the possible reason for this to poultry semen having a relatively long mid-piece than mammals.

The abnormal spermatozoon rate of 17 ± 0.06% was similar to one study (8), and higher than others (6,18). This difference can be attributed to the breed of turkey used, live-weight, season, environmental temperature and humidity, ration size and semen collection techniques. Acrosome (41 ± 0.24%) and mid-piece abnormalities (25 ± 0.12%) were the leading abnormality types at 66 ± 0.36% in the present study. This result confirms the

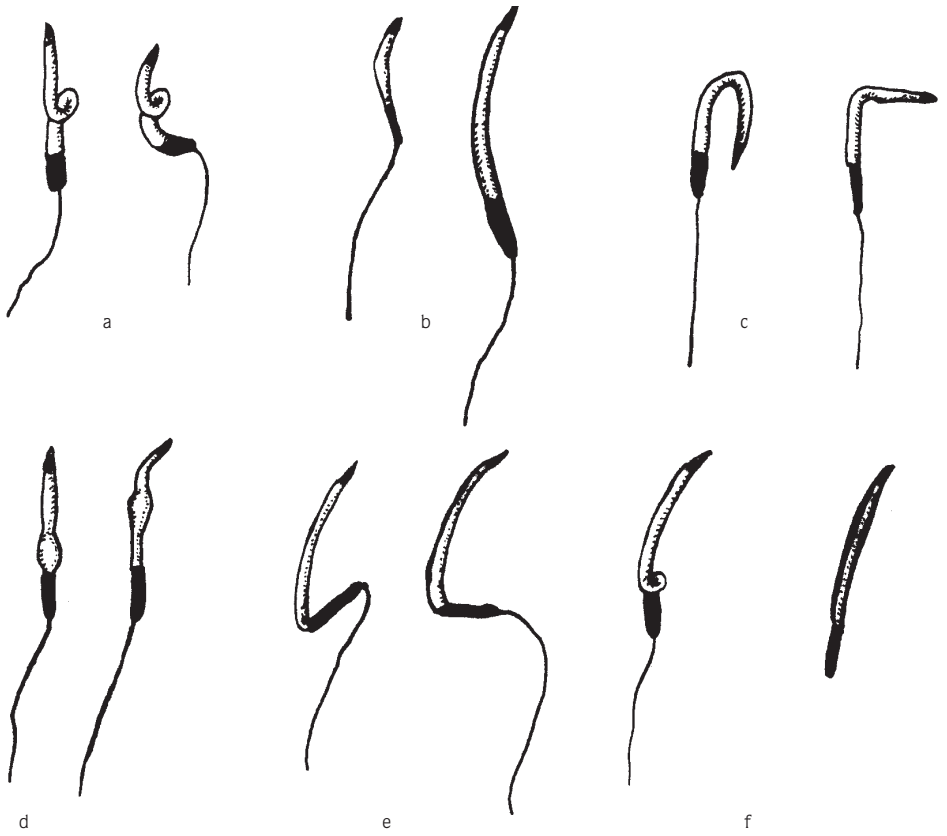

Figure 2. Head abnormalities.
a) Knotted head, b) Smaller or larger head, c) 90° or 180° bent head, d) Head Swelling, e) Bending or knotting at head-mid-piece border, f) Head detachment

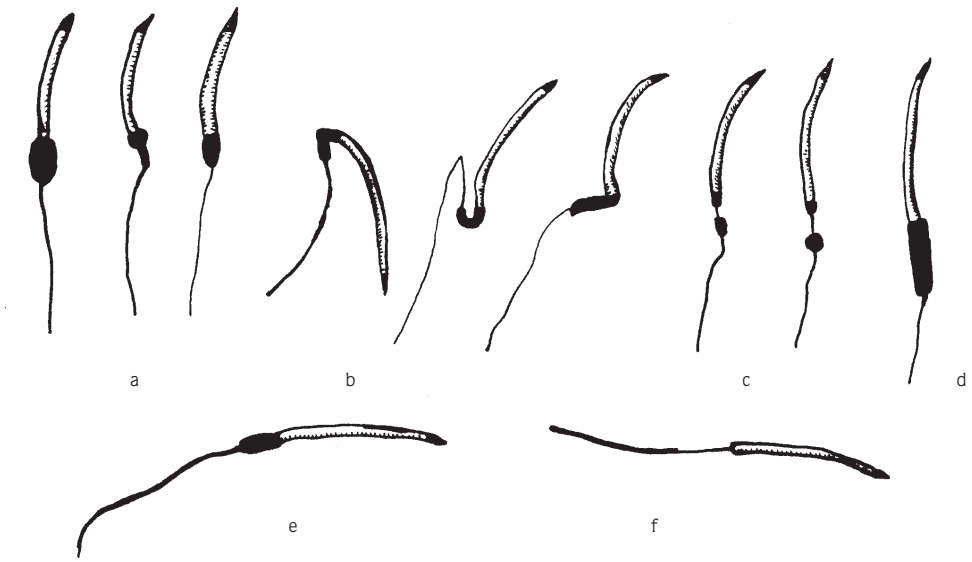

Figure 3. Mid-piece abnormalities.
a) Mid-piecei swelling, b) Mid-piece bending, c) Mid-piece partial detachment, d) Mid-piece thickening, e) Mid-piece vacuoligsation, f) Mid-piece detachment

Figure 4. Tail abnormalities.
a) Tail detachment, b) 90° bent tail, c) 180° bent tail, d) Curled tail, e) Tail knotting

results of a number of researchers who reported that the acrosome and mid-piece were the most sensitive regions of poultry spermatozoa (7,11). It was also pointed out that the connection point between the head and mid-piece of poultry semen is very sensitive to external factors (17).

Mid-piece abnormalities were the second most common abnormality at 25 ± 0.12% in the study, the most frequent types were bending, swelling and detachment (Figures 3a-c and f). Researchers with similar results suggested that mid-piece abnormalities were due to the sensitivity of this region, as it deteriorates quicker than other regions and the tail's movements cause bending (7,12).

Head defects scored 11 ± 0.11% of the total. The most common head defect types were large or swollen head (Figure 2d) and knotted head (Figure 2a). Sevinç et al. (9) reported similar defect types in cock semen. However, Tsukunaga (11) stated that poultry semen could swell in seminal plasma after ejaculation and it was difficult to determine the abnormal swelling rate.

Tail defects were 22 ± 0.18%, and the most frequent types were folding, bending and knotting of the tail (Figures 4b,c and e). The results of the present study were similar to some studies, but researchers claim that tail defects in poultry semen are secondarily occurring mechanical defects that cannot be considered as true (primary) defects (9,11).

In conclusion, morphological defect types of turkey and cock semen are similar and the most frequent defects are observed at the acrosome and mid-piece, suggesting that these organelles are the most susceptible to environmental factors.

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