

## **Meat Products as Potential Doping Traps?**

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Recently published news regarding food safety in China caused some worldwide disturbance and uncertainty among top athletes and their supporting staff. According to an article in *The New York Times*, a member of the U.S. Olympic team discovered oversized chicken breast when visiting a supermarket in Beijing, China. More interesting, the chicken contained considerable amounts of anabolic steroids, which were reported to be large enough to cause a failed doping test after ingesting the meat (Shpigel, 2008). Based on this case report it appears necessary to assess the danger posed to our (Olympic) athletes by foods and especially meat products on a more general basis. More important, our athletes are involved in worldwide travel during the competitive season. Therefore we must consider not only our athletes' local food choices but also the wide variety of foods and regional delicacies our athletes might be confronted with in foreign countries.

### **Doping Risk Resulting From Drug Administration During Animal Fattening**

Anabolic agents, especially anabolic steroids, have been illegally—and in some countries legally—fed to animals. Theoretically, consuming meat originating from treated animals could result in inadvertently failing a doping test. Some evidence of this is provided by Kicman et al. (1994), who administered the anabolic steroid methenolone to chicken as a fattening agent. In this study the steroid was administered intramuscularly as three injections (per 1 mg) within 14 days. Eight days after the third injection the chicken meat was prepared and eaten, which led to 4 of 8 volunteers testing positive for a metabolite of methenolone as long as 24 hr after ingesting the meat.

Debruyckere, de Sagher, and Van Peteghem (1992) also investigated the administration of anabolic steroids to veal and cattle during fattening: After ingesting raw minced meat obtained from favored butchers, 1 of their volunteers provided a urine sample containing metabolites of the anabolic steroid clostebol. Because anabolic steroids are chemically stable when exposed to heat, it is likely that previous cooking of the meat would have led to similar results.

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In a follow-up study, minced meat was obtained from 50 butchers all over Belgium. Again, 2 volunteers tested positive for nandrolone and clostebol after eating the beef (Debruyckere, Van Peteghem, & de Sagher, 1993).

The amount of steroids injected for fattening is obviously unknown, but several studies have shown that even minor amounts of norandrostenedione (as little as 10  $\mu\text{g}$ ) could have caused positive doping samples (Catlin et al., 2000; Geyer, 2004; Judkins, Russell, Jennings, & Watson, 2006; Tseng, Kuo, & Sun, 2005).

These results demonstrate that a positive doping sample might be a consequence of consuming contaminated meat, especially when the meat around the injection site has been processed. The risk could even increase in countries lacking efficient quality-control procedures. As of today, doping analysts are not capable of differentiating between anabolic steroids self-administered for doping purposes and unintentionally ingested synthetic steroids from food.

## Doping Risk Resulting From Naturally Occurring Hormones

Besides the apparent danger when consuming meat from animals that were administered drugs, meat from animals exhibiting naturally high levels of certain steroids should also be considered a doping risk.

Because of the naturally high concentrations of nandrolone and norandrostenedione (precursor of nandrolone) occurring in meat and offal from boar (domestic and wild), this meat has been of special interest. Le Bizec et al. (2000) fed 3 volunteers boar meat and offal (heart, kidneys, and liver). Up to 24 hr after the meal, 19-norandrosterone and 19-noretiocholanolone were detectable in urine samples from all participants. According to doping regulations, this would have been considered a positive finding for nandrolone or prohormones of nandrolone.

Ayotte considers the doping risk resulting from boar offal to be minor, because boar is usually not used in food processing (Ayotte, 2006). In some countries, however, boar is regarded as a delicacy and can be obtained easily in butcher's shops.

Sterk, Linders, von Ginkel, and Stephany (2002) detected nandrolone in liver sausages that had been purchased from supermarkets in the Netherlands. It turned out that boar liver might have been used in the production process of these sausages, which were labeled to contain 20–40% pork liver. Even though the detected amounts of nandrolone were considered to be minor, the authors concluded that greater intakes of liver sausage or cooked liver could lead to failing a doping test.

To differentiate whether the urinary nandrolone metabolites originate from a natural source or from administration of synthetic anabolic steroids, a detection method based on carbon isotope ratio mass spectrometry was developed at our institute (Hebestreit et al., 2006).

## Conclusion

Scientific data demonstrate that ingesting certain meat products can cause positive doping tests. From the current point of view, the risk cannot be quantified for single countries. If doping agents have administered in animal feeding, however,

it appears impossible for an athlete to track the adverse analytical finding back to the consumption of contaminated meat. In contrast, the unintentional uptake of naturally occurring hormones such as in boar can be detected by advanced analytic procedures.

For proper protection from doping risks resulting from meat products, athletes, as well as their supporting staff, should consider the following advice, especially in foreign countries:

- At international events, meat products should only be obtained from officially accredited caterers (which is the case in the Olympic village).
- Preferably whole meats (such as steaks) should be eaten; athletes should refrain from minced meat.
- Athletes should also refrain from eating indefinable meat dishes (such as pasta filled with meat), which could be made from low-quality meat.
- Athletes should avoid eating boar meat.
- Athletes should avoid eating pork offal.

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## Erratum

In the article “Effect of Red Bull Energy Drink on Repeated Wingate Cycle Performance and Bench-Press Muscle Endurance” in the *International Journal of Sport Nutrition and Exercise Metabolism*, 17(5), 2007, it is mentioned in Paragraph 3, Page 440, that Red Bull energy drink contains carnitine. This is incorrect. Red Bull does not contain carnitine. The authors regret this error.