

Research Article

Establishment of Food Quality and Safety Management in Athlete's Restaurant Based on Prevention and Control of Food-borne Doping

Jun Yao

Jilin Sport University, Changchun, Jilin 130031, China

Abstract: This study analyzed the present situation of food-borne doping and related cases using the method of document literature, expert interviews, etc., identified and evaluated the risk of catering link in athlete's restaurant combining the quality control, food safety management theory and athletes dietary management characteristics and established food quality and safety management system in athlete's restaurant by drawing a lesson from the successfully applied experience of ISO9001 and ISO22000 system, which aimed to provide a new approach to improve dietary management level.

Keywords: Athlete's diet, clenbuterol, food-borne doping, food safety, management system

INTRODUCTION

Doping event will cause serious negative effect on organizations and individuals. In recent years, doping also disturbs meat safety besides drug. From the perspective of the organization of major sports events at home and abroad, food safety is particularly valued by the tournament organizing committee. At present, the sports management department and the World Anti-Doping Organization (WADA) both have recognized that some foods are likely to lead to positive reaction in doping test. Punishment of doping is "strict liability". Therefore, the punishment shows no mercy as long as the inspection result is positive, no matter the athletes eat it or not. Because there are some positive doping cases caused by food pollution and increasingly prominent food safety problems in recent years, food safety and security work gets a lot of pressure and food security and food-borne doping control have become one of the important contents of the management services in each sports training base (Zhang *et al.*, 2010; Li *et al.*, 2014; Hu, 2008; Zhai *et al.*, 2011). This study analyzes various cases and combines all kinds of theories so as to provide a new approach for improving dietary management level.

MATERIALS AND METHODS

The overview of food-borne doping: Some foods naturally contain doping ingredient, such as caffeine, coffee, tea, chocolate and other food drinks, which are listed as banned drug repeatedly by the international anti-doping organization and are uninhibited time after time. It is still required to be forbidden for drivers in the competition of Fédération Internationale de l'Automobile (FIA). In general, doping that naturally

contains in food is relatively easy to identify and control, as long as we do not eat these food, while the source of doping in the poultry meat is very complex.

Because the traditional feeding model of livestock already cannot satisfy the requirements of today's society, long-term use of a large number of various kinds of pesticides, antibiotics and other glucocorticoids in veterinary drugs can cause residues in animal derived food and transmit with the food chain, eventually become a source of food-borne doping (Feng *et al.*, 2012; Mao *et al.*, 2011). The possibilities of the irrational drug use, malicious drug accretion, artificial addition in circulation link or secondary pollution in the process of storage and transportation bring about great difficulties to control the doping (Shi and Wang, 2010). In 2008 Beijing Olympic Games eve, Accreditation Administration of the People's Republic of China (CNCA) issued testing project of Olympic forbidden drugs control, including four categories of β -agonists, Chemosynthetic Steroids, Glucocorticoid Steroids, Zeranol, totally 34 kinds, according to the standard of WADA. In all food-borne doping, the hardest to prevent is "clenbuterol". "Clenbuterol" is β -adrenergic agonist that is a common name for various animal medications, which are used to improve lean of livestock, including forbidden β -doping of Clenbuterol Hydrochloride, Ractopamine, Salbutamol, etc. At present, clenbuterol hydrochloride is the most prominent illegal addition in domestic meat products.

RESULTS

Positive clenbuterol cases and analysis of food control standards:

Table 1: Part of positive clenbuterol cases over the past 20 years

Year	Country (region) /sports event	Athletes with positive clenbuterol	Categories (detected place)	Notes
1992	U.S./track and field	B. Darcy (female)	The 25th summer Olympic Games in Barcelona	
1994	China/swim	Xiong Guoming	Hiroshima Asian Games, the last two times in Bangkok Asian Games	Two positive detections
1999	China/swim	Wang Wei	Spot check	
1999	China/swim	Wang Wei	Spot check	
2004	The Republic of Belarus /track and field	A. Les Niki	The 28th summer Olympic Games in Athens	
2004	Uzbekistan /track and field	O. Shichukina (female)	The 28th summer Olympic Games in Athens	
2005	China/swim	Zhou Jie (female)	Spot check	
2008	China/swim	Ou Yang Kunpeng	Spot check	
2008	China/swim	Yi Changming	Spot check	
2008	U.S./swim	Hardy (Jessica Hardy)	Qualification trials of swimming in U.S. Olympic Games	
2009	China/judo	Tong Wen (female)	After the world championship of judo in Dutch	0.07 ng detected quantity, the detection of bottle B was sentenced to program violation and canceled the penalties
2009	China/track and field	Ou Yongjian	Check in the game	
2010	Hong Kong /badminton	Zhou Mi (female)	Spot check during the open tournament in Singapore	
2010	Spain/cycling	Contador (Alberto Contador Velasco)	Detection in Tour of France	0.05 ng detected quantity
2010	German/table tennis	Ovtcharov (OVTCHAROV Dimitrij)	Regular spot check in German	Hair did not content the doping and canceled the penalty
2011	Players from all over the world	109 players in 19 teams were checked out (accounted for 52.4% in detected players)	U15 FIFA World Cup in Mexico	Caused by food safety issues, all of them were pardoned
2011	Mexico/football	Five players	North, Central American Football Gold Cup	

Case analysis of positive clenbuterol in athletes: On the 25th summer Olympic Games in Barcelona in 1992, one track and field athlete from United States was tested to be positive clenbuterol. Then in a series of detections in sports competition and out of competition at home and abroad, positive clenbuterol had been repeatedly reported and many athletes were punished by taking or wrongly taking “clenbuterol” (refer to Table 1). Clenbuterol terrified sports circles since most of the athletes committed “wrongly taking contaminated meat” as the reason for positive doping and meat safety issues got unprecedented attention.

The clenbuterol belongs to exogenous intake and there is no endogenous secretion, therefore, the doping is positive as long as the residue is found in urine of athletes. And new standard of WADA laboratory testing technology was implemented on January 1st, 2013 formally, the limitation of detection of clenbuterol was increased from 2 ng/mL to 0.2 ng/mL. The adjustment of the standard increased the risk of positive clenbuterol for athletes.

Research has shown that residues of clenbuterol in animals mainly concentrate in eyes, hair, lungs, liver, kidney, muscle and adipose tissues, the residue in the retina and choroid of the eyes and hair are supreme;

second is the lung, liver and kidney; muscle tissue accounts for about 1/5 of the liver (Ding *et al.*, 2009). In the 2012 London Olympics Games Eve, the WADA and British officials respectively warned players around the world: “do not eat too much contaminated meat, especially the intake of animal liver”, in order to avoid the punishment by detecting the illegal drugs clenbuterol in body.

The unsatisfied needs of athlete’s food safety for current food safety standards: General Administration of Sports of China once noted that each batch of meat offered by suppliers should conduct special tests according to the limitation standard of 0.05 ng/g of clenbuterol in the meat that eats by athletes and provide a written inspection certificate. According to the current national standard Safety Qualification for Agricultural Products-Safety Requirements for Non-environmental Pollution Meat and Other Animal Products (GB18406.3-2001), the detection limitation of non-environmental pollution meat for clenbuterol hydrochloride is 0.01 mg/kg (10 ng/g), which is 200 times as high as the safety meat standard of athletes. According to the Ministry of Agriculture standards Green Food-Meat and Meat Products (NY/T 843-2009),

the detection limitation of clenbuterol hydrochloride for green meat and meat products is less than 0.002 mg/kg (2 ng/g), which is 40 times as high as the meat standard of athletes. The demand of athlete's meat for detection limitation of clenbuterol is far more than the requirements of green food and non-environmental pollution food standard in our country.

From the end of 2012 to March 2013, anti-doping center of General Administration of Sports of China detected 18 cases of positive clenbuterol for local sports training base in a total of 798 cases of meat food sample of the test statistics, in which 1 case was pork, 17 cases were beef and mutton. The overall detection rate was 2.3% and the concentrations of the majority of positive clenbuterol samples were higher than 0.1 ng/g, 8 ng/g as the highest (Wang *et al.*, 2013). However, the proportion and the content of clenbuterol in meat products in the market were much higher than safety standards of athlete's meat food and unable to meet the security needs of the athlete's diet. Therefore, the security assurance of food for athletes was very serious.

DISCUSSION

Prevention and control of food-borne doping and measures of food safety management:

Key control in the process of meat processing:

Analysis of key control segment: According to the requirements of the food-borne doping control of athletes, we analyzed the meat processing in restaurants and finally selected four critical control points (Fig. 1).

Formulation of control measures: We do not use meat products that may have been contaminated when making recipe and nutritional recipe solutions for athletes. Because the rules of metabolic residues of clenbuterol in different tissues in animal body are different and the residue in the eyes and viscera was the highest, we cannot take animal giblets as athlete's food. In order to ensure the security of food, a lot of sports management departments have to require gastric disorder or less pork, beef and mutton before the game so as to reduce the risk of athlete's doping due to food contamination. We can diversify the diet on catering and add shellfish, fish and poultry food appropriately in order to ensure the quality requirements of athlete's diet.

We should be strict on raw materials procurement, select suppliers rigorously and implement sentinel procurement, require and verify certification of each batch, especially the inspection of meat food. The critical limit of food-borne doping should meet the athlete's requirements for safe pork and needs professional laboratory trace analysis and ultra trace detection technology. The high sensitivity and accuracy methods are Gas Chromatography-Mass Spectrometry (GC-MS), liquid chromatography-mass spectrometry (HPLC-MS), etc.

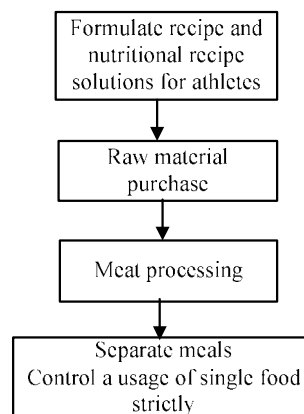


Fig. 1: Critical control points of meat processing

In the process of meat processing, because the nature of "clenbuterol is soluble in water and meat containing the drug destroys half residue after frying in 126°C for 5 min" (Ding *et al.*, 2009; Zhang and Cai, 2007), we can increase blanch action in processing, consider more boiled meat and fried meat and add chili food appropriately by using the regional characteristics of eating chili in order to reduce the broth consumption and the risk of positive clenbuterol.

As to separate meals for athletes, according to the research results of Zhang *et al.* (2010): "athletes will not be tested as positive doping when total quantity of clenbuterol hydrochloride is within 1 µg in single consumption of pork products" (Zhang *et al.*, 2010). Restaurant for athletes should control the one-time intake of single food, especially the contaminated livestock meat and diversify the diet, in order to prevent exceeded clenbuterol from excessive consumption of contaminated food.

Establishment of food safety management system:

Frequency of meat inspection is relatively low due to the limitations of detection technology, inspection cycle and cost. How to strengthen athlete's diet management and establish long-term and effective food safety supply mechanism are the important parts of quality management when doing a good meat inspection work. Draw a lesson from successful application experience that is widely used in international standards of ISO9001, HACCP and ISO22000 in food industry can effectively solve the problem of athlete's food quality and safety of large sports training bases (Guo *et al.*, 2010; Yu, 2009).

Introduction of management system: The objects, purposes and priorities of ISO9001 quality management system, HACCP hazard analysis and critical control point system and ISO22000 food safety management system are different. ISO9001 emphasizes that quality of products can meet the requirements of customer (namely in the athlete's restaurant); HACCP and

Table 2: Hazard analysis worksheet of athlete's meal production process (take raw material purchasing as example)

Processing procedures	Potential hazard	Obvious hazard or not	Determination basis of significance	Control measures	CCP or not
Raw material purchasing	Biological: pathogenic bacteria, parasite	Yes	Livestock and poultry meat, egg, milk, bean products may be polluted by pathogenic bacteria, raw meats may contain parasites; livestock and poultry meat may have clenbuterol and other food-borne doping; the drug residues in fruits and vegetables; the foreign bodies in grain, etc.	Implement sentinel procurement; require and verify certification of each batch; do not purchase animal's giblets; use it after testing qualified; control the temperature strictly of livestock and poultry meat, egg, fish and other raw materials; purchase pollution-free green vegetables	Yes

Table 3: HACCP plan

CCP	Obvious hazard	Critical limits	Monitoring				Corrective measures	Record	Verification
			Object	Method	Frequency	Personnel			
Raw material purchasing	Drug residue of clenbuterol	With/without (clenbuterol ≤ 0.05 ng/g) positive/negative	Livestock and poultry meat	Laboratory testing visual	Each batch	Purchaser	Refuse	Purchasing records, unqualified food disposal form, warehousing registration form	Check each record, survey suppliers once every half a year, inspect drug residue for each batch of livestock and poultry meat and vegetable

ISO22000 focus on food safety management and prevent consumers (namely athletes) from hazard. ISO22000 integrates the HACCP system formulated by Codex Alimentarius Commission (CAC) and implementation procedures and puts forward it should combine with the premise schemes (CPRP). For athlete's restaurant, premise schemes includes Good Manufacturing Practice (GMP), Sanitation Standard Operating Procedures (SSOP), purchasing management and supplier control, food storage and transportation management, maintenance of equipments, water electricity guarantee, restaurant's environmental health requirements, food processing, lampblack and sewage discharge and waste disposal, emergency preparedness and response control, information communication, etc.

Application of management system: Application of ISO22000 mainly includes premise schemes (please refer to 3.2.1), hazard analysis and recognition, HACCP plan, operation of food safety management system, product recall and so on. HACCP puts forward seven principles as the implementation bases, namely conduct hazard analysis, propose prevention measures and determine the critical control points, establish the critical limits and monitor critical control points, correct actions, record and keep procedures and verify procedures. We consider each step in the technological

process of meal processing as a control point, analyze hazard and find out the critical control points, establish control standard and determine the monitoring measures, correct procedures and record a complete process.

In order to ensure the food safety of each link in the process of food production, we need to analyze hazard from the three aspects of biological, chemical and physical hazards involving in specific steps in each link of restaurant's production activity, determine the Critical Control Points (CCP) and form hazard analysis worksheet of athlete's meal production process. Table 2 is just the hazard analysis worksheet of raw material purchasing; it should also include warehouse storage, cutting and rough machining, cooking, disinfection of container and separated meals for sale, etc.

According to the national, industrial and internal standards, we should determine the limits of the critical control points and ensure monitoring and corrective measures, keep complete records and establish HACCP plan (Table 3).

As to monitor and correct measures, we need to implement the traceable management in addition to controlling purchase strictly. Full food traceability system has double functions of "trace" and "track", which can be guided scientifically by communicating with breed base sufficiently. We implement dynamic

monitoring of doping material and the monitoring in withdrawal period, keep records and establish a complete database; at the same time, we set up system of meat reserved samples for future reference in athlete's restaurant, launch the food safety emergency contingency plans immediately once positive samples are found. And also we find out the source of the problem of food through the food traceability system and process doping event in a timely manner.

Integration of management system: Although ISO9001 and ISO22000 system have their own emphasis, they have compatibility. The eight quality management principles of ISO9001 quality management system and the concept of excellence group are integrated into the ISO22000 food safety management and the mutual connection and interaction are managed systematically. Food quality and safety management system is integrated according to the requirements of their standards, which can effectively improve the overall performance of the organization.

CONCLUSION

Athlete's food safety management cannot rely on establishing standalone vegetables and breeding base by reasons of operating costs and policy. From a long-term perspective, the implementation of whole process supervision from farm to dining table and the change of current situation of meat safety depend on the focus of the whole society and cooperation from various aspects. Food-borne doping and other threats can be effectively controlled through taking measures for critical points in athlete's restaurant. Establishment of ISO9001 and ISO22000 system in athlete's restaurant is one of the effective ways to enhance the level of food quality and safety, internal audit and self assessment are effective food safety management measures and means and authentication can be an auxiliary mean to effectively maintain quality management system.

REFERENCES

Ding, X.D., X.S. Huang, Y.Z. Lin, W.P. Zhang and Z.X. Lin, 2009. Research progress of detection method of clenbuterol hydrochloride. *Guangdong Agr. Sci.*, 5: 6-8.

- Feng, L., J.C. Huang, X. Liu, M. Huang and G.H. Zhou, 2012. Research progress on rapid detection of food-borne bacterial pathogens. *Food Sci.*, 33(21): 332-339.
- Guo, F., Z.J. Zhang, M.H. Chen and H.S. Li, 2010. Application of the HACCP system in Beijing Olympic games and its enlightenment on food safety management in China. *Food Nutr. China*, 5: 4-8.
- Hu, J.M., 2008. Guarantee of exposed foreign body, food-borne doping with thermo fisher. *Food Saf. Guide*, 6: 28-29.
- Li, L., X.H. Jiang, C.Z. Li *et al.*, 2014. The 12th national games conference on risk identification and evaluation of food safety in 2013 in Dalian area. *J. Public Health Prevent. Med.*, 3: 16-19.
- Mao, X.D., J.F. Hu and X.M. Liu, 2011. Epidemiological burden of bacterial food-borne diseases in China-preliminary study. *Chinese J. Food Hygiene*, 23(2): 132-136.
- Shi, C.G. and K. Wang, 2010. Construction of food quality and safety management system: Based on food-chain. *J. Zhongnan Univ., Financ. Econ.*, 170(1): 29-34.
- Wang, Q.P., J. Ha, S. Liu, J.L. Zhang and M. Su, 2013. Research progress of detection methods of clenbuterol hydrochloride. *Hebei J. Ind. Sci. Technol.*, 30(2): 125-129.
- Yu, Y.X., 2009. Overview of food safety and control of food-borne disease. *Guide China Med.*, 7(12): 185-186.
- Zhai, F.L., K.Q. Lai, Y.L. Zhang *et al.*, 2011. General introduction to β -agonists residues in foodstuffs of animal origin. *Food Sci.*, 32(5): 351-356.
- Zhang, J.L., Z.L. Wang, Z. Gao, X. Liu and Y. Zhang, 2010. The possibility of positive urine for doping of clenbuterol hydrochloride resulting from edible meat. *Chinese J. Sport. Med.*, 5: 580-583.
- Zhang, Y.L. and S.K. Cai, 2007. It is imperative and extreme urgent to control clenbuterol residue hazard. *China J. Anim. Quarantine*, 24(11): 19-21.