V - SELECTION OF VOLUNTEERS
Nandrolone (19-nortestosterone) is an anabolic steroid which is banned by the WADA in the sport of practice. The two major metabolites detected in urine are 19-nandrostenedione (19-NA) and 19-nortestosterone (19-NE). An urine is considered as positive if 19-NA > 2 ng/ml in male and females athletes. This threshold is supposed to exclude any potential natural production.

II - AIM OF THE STUDY
1. Study the excretion patterns after oral intake of 13C-nandrolone and the degree of inter-variability over a population of trained athletes. This will be compared to data obtained in declared positive cases in top level sports.
2. Evaluate if exhaustive exercises could influence the 19-NA and 19-NE urinary excretion rates after oral administration of labeled nandrolone.
3. The ratio 19-NE/19-NA will be investigated regarding the possible endogenous production of nandrolone by the human body.

V - SELECTION OF VOLUNTEERS
34 male volunteers (19-27 years) have been selected out of a pool of sport students (Institut des Sciences du Sport et de l’Education Physique, University of Lausanne, Switzerland). They were randomly assigned to one of the two groups:

Placebo: no medication (n=12)
Treated: subjects received two oral doses of 25 mg 13C-nortestosterone (n=22)

The entire protocol was performed on a double blind basis.

2. VARIATION OF METABOLITES CONCENTRATIONS AFTER PHYSICAL EFFORT
As the major elimination of the labeled metabolites after oral ingestion of 13C-nandrolone is very fast, relative low concentrations were found already after the first session (on day 11). Consequently, the metabolites were quantified only for the two first efforts that followed the treatment. No clear effect of exhaustive exercises can be pointed out.

III – PROTOCOLE OF THE STUDY
The exercise sessions (1) were organized by the Sport University Department. Those consisted in one hour multi-sprint exercise at 80-90% of the maximal cardiac frequency. A medical control (MC) was done at the beginning and at the end of the trial. This allow to make comparisons between the two groups.

The 5 days following the administration of the two doses of 13C-nandrolone, each volunteer had to provide a 100 ml aliquot of all their urine for the establishment of the excretion kinetics (ES period). In order to evaluate the effect of physical effort on the 19-NA and 19-NE urinary concentrations, the volunteers had to provide the urines before and after each exercise session (2).

VI – EXERCISE SESSIONS PLANNING
In order to simulate a football training, the exercise sessions were planned by the specialized staff of the Centre of Sport and Health Analyses (CASS) of the University of Lausanne. 2 and 6 sessions of exercises were applied before (days 5 and 6) and after (days 11, 13, 15, 18, 20 and 27) the 13C-nandrolone oral administration. The sessions were planned to be an intermittent training.

Heart rate monitoring during the exercise sessions. Each session consisted of a warming period (12 min) and four exhaustive exercises types (12 min): a football match, 12 sets of 50 sec sprint followed by 20 sec place, a rugby match and a technical course interspersed with breaks (5 min).

3. RATIO BETWEEN METABOLITES
The ratio between 19-NE and 19-NA can change a lot for some of the volunteers whereas it stays relatively constant for others.

Constant ratio

Variable ratio

19-NA and 19-NE excretion curves of the 22 treated subjects. Each individual had to provide 100ml of every spot urine during five days after the 13C-nandrolone administration. The concentrations are normalized with the specific gravity. The scales are the same for the two metabolites to allow comparisons.

VIII – CONCLUSION
1. The metabolism of oral nandrolone may vary a lot between individuals.
2. No clear statement can be established concerning the consequence of physical effort on the nandrolone metabolites excretion in urine because of significant inter-individual variability.
3. The ratio between the metabolites is not the same for all individuals along the time. This makes the interpretation of this parameter very poor.
4. These results strengthen the fact that nandrolone metabolites found in urine is still a complex problem and that actually, each nandrolone positive case must be considered with caution.

Linthor Christie (GBR), the 1992 Olympic 100-meters champion, was tested positive for nandrolone in February 1999. He was subsequently cleared of doping by his national body UK Athletics. This decision was then contested by the International Amateur Athletic Federation (IAAF) which banned Christie for two years of competition.