



## Bulletin d'information mensuel

### *Les effets de l'altitude sur la performance et l'endurance*



*Par Pierre Albert  
Hutsebaut, entraîneur  
certifié niveau IV*

Pour le bénéfice des  
lecteurs du bulletin du  
PEAK Centre de Haute  
Performance de Montréal



#### *Pleins feux sur :*

- Présentation de  
l'appareil G02
- Nos services
- Article scientifique de  
Dr HAMLIN de  
l'université Lincoln-N2

Le système de GO2 Altitude présenté par Peak Centre Montréal lors des récentes manifestations sportives a suscité beaucoup d'intérêt et de demande d'information. Voici quelques articles qui peuvent vous éclairer sur le sujet. Comme beaucoup d'articles de ce genre, ils sont en anglais mais une traduction risquerait de déformer les faits présentés par les auteurs, c'est pourquoi nous vous les offrons dans leurs versions originales.

Le système GO2Altitude est un appareil qui simule les conditions atmosphériques en atmosphère raréfiée en oxygène. Au niveau de la mer, la composition de l'air est d'environ 20-21% en oxygène. Lorsque l'on s'élève, ce pourcentage diminue, il est par exemple de 12 % à 4500 m et de 9% à 6500 m. Le programme proposé par le Peak Centre de Montréal consiste à entraîner l'organisme à s'adapter à ces conditions d'oxygène raréfié. Pour cela, le Peak Centre utilise l'approche IHT (Intermittent Hypoxic Training) qui comme son nom l'indique est un programme d'entraînement par intervalles. Vous savez sans doute les bénéfices réels de tout entraînement par intervalles en termes d'adaptation.

Le Peak Centre suit donc des principes d'entraînement bien établis, à savoir, le principe de surcharge, le principe de spécificité, le principe d'adaptation et le principe de récupération.

**Spécificité et adaptation:** on simule des atmosphères de plus en plus élevées donc de plus en plus pauvre en O2 comme on en rencontre lorsqu'on fait de l'alpinisme ou un stage d'entraînement en altitude ce qui oblige l'organisme à s'adapter progressivement à ces conditions.

**Surcharge et récupération :** pour commencer, on détermine quel sera le niveau d'altitude que l'athlète pourra supporter sans inconfort. Il est évident que si l'on simule d'entrée une altitude de 5000 à 6000 mètres, on risque de ne pas se sentir très bien! Puis cette estimation étant faite, on procède par courtes séances ( 5 minutes à la fois) suivies de périodes de récupération à l'air ambiant. Comment fait-on cela? En appliquant et en ôtant le masque qui relie le patient au simulateur d'altitude.





L'alpinisme



## Que proposons-nous ? le GO2 altitude®, à quoi ça sert ?

Le Peak Centre propose une série de 12 séances de IHT espacées sur une période maximum de 4 semaines. Les effets se feront sentir pendant plusieurs semaines après l'arrêt du traitement. Il est alors conseillé de reprogrammer des séances à intervalles donnés pour en tirer le plus grand bénéfice. C'est comme un plan d'entraînement annuel, il y a des phases et des cycles déterminés en fonction des objectifs de chacun.

En somme, ce système permet d'appliquer l'approche « Train low, Live High » dont vous trouverez plus de détails dans la fiche de recherche suivante :

[http://www.savoir-sport.org/savoir\\_sport/index\\_f.aspx?ArticleID=220@criteria=hypoxie&templateID=14](http://www.savoir-sport.org/savoir_sport/index_f.aspx?ArticleID=220@criteria=hypoxie&templateID=14)

### le système GO2 altitude sert à :

- Simuler les conditions d'oxygénation (pauvres en O2) de 2500m à 6500m d'altitude
- Améliorer votre capacité de transport de l'oxygène aux muscles
- Améliorer votre VO2 max
- Améliorer votre condition physique générale
- Améliorer votre système immunitaire
- Vous donner plus d'énergie au quotidien en augmentant votre endurance et votre résistance au stress

Le système GO2 altitude, à la fine pointe des méthodes d'entraînement en hypoxie !!!

Pour en savoir plus : [www.go2altitude.com](http://www.go2altitude.com)

### Pour les amateurs d'alpinisme,

il est certain que votre adaptation à l'altitude vous fera gagner de nombreux jours dans votre expédition. Traditionnellement, vous devez progresser par paliers pour permettre à votre organisme de s'adapter. Grâce au système GO2Altitude du Peak Centre, vous serez prêt à affronter vos défis de montagne dès votre arrivée. Plus de crainte à propos du mal de montagne, de maux de tête, d'œdème pulmonaire si vous vous êtes correctement acclimatés avant de partir.

Il est remarquable de constater que cette approche fait désormais partie de l'entraînement des pilotes. Pour en apprendre plus, nous vous référons au site :

<http://www.hypoxic-training.com>



### Quelques définitions

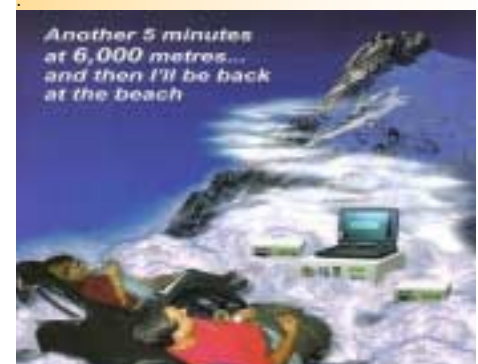
#### INTERMITTENT HYPOXIC TRAINING

**Hypo:** reduced, lack

**Oxy:** relating to Oxygen

**Definition:** Breathing air with reduced oxygen content ("mountain air") resulting in enhanced athletic performance and general health and wellbeing.

**Intermittent:** cycling between hypoxic and normal air that magnifies the efficiency of hypoxic training



## Simulated altitude training shows benefits

Page 3 sur 4

### OU SOMMES NOUS SITUÉS ?

6982 Cote de Liesse  
Montréal, Qc  
H4T 1Y5

### Téléphone :

(514) 341-7325  
1-877-878-PEAK

### Télécopie :

(514) 341-2574

### Adresse électronique :

[info@peakcentremontréal.ca](mailto:info@peakcentremontréal.ca)

*Il faut compter dix ans  
d'entraînement intensif  
pour exceller en quoi que  
ce soit.*

*Herbert A. Simon,  
Prix Nobel (1916-2001)*

Nous sommes sur le Web !

### Adresse :

<http://www.peakcentremontréal.ca>



Groundbreaking research at Lincoln University, supported by the Canterbury Medical Research Foundation, has shown that intermittent, simulated altitude training for athletes can boost the formation of immature red blood cells, important for carrying oxygen around the body.

Under the leadership of sports scientist Dr Mike Hamlin of Lincoln University's Environment, Society and Design Division, assisted by physician Dr John Hellemans of Active Health, QEII, Christchurch, the effects of "intermittent hypoxic training" (IHT) on athletic performance were investigated.

Hypoxic refers to lack of oxygen, such as that experienced at high altitudes, and athletes in many sports have long used altitude training as a way of building up the important oxygen-carrying red cells in the blood before launching into demanding, energy-sapping events. The All Blacks use the principle when they "acclimatize" on South Africa's High Veldt before playing at Johannesburg, around 5500 feet above sea level. "Acclimatization can, however, be costly and time-consuming," says Dr Hamlin. "To spend lengthy periods fulltime at high altitude training camps ahead of an event can drain budgets and strain relationships. How much better if the same physiological effect can be achieved intermittently in simulated circumstances close to home, at a fraction of the cost."

Simulated altitude training devices have become a popular alternative for many athletes but whether they are beneficial or not has been a matter of debate. Lincoln University's research has come up with the first randomized double-blind, experimental data indicating that the devices may be an effective, cheaper and more convenient method of applying an altitude stimulus to endurance athletes. The regimes the athletes were exposed to were the equivalent of oxygen levels in the air at the top of Mount Cook and even higher.

Twenty-two multi-sport endurance athletes were randomly assigned to either a placebo or hypoxic group.

The subjects were similar in age, height, weight and competitive level. Over three weeks in daily 90-minute sessions on an average of five days per week, the two groups breathed through hand-held facemasks connected to a commercially available hypoxicator device.

For the IHT group the intermittent breathing was administered in a ratio of five minutes hypoxic air followed by five minutes of normal air. The oxygen concentration in the hypoxic gas was progressively reduced in the IHT group from 13% in day 1-2 to 10% by week 3.

Blood samples were taken at intervals and analyzed. The subjects were also put through running time trials to determine the effect of IHT on performance.

All in all the researchers were able to conclude that the use of intermittent normobaric hypoxia in five-minute intervals for 90 minutes a day, five days a week for three weeks, was sufficient to elicit blood changes that suggest an acceleration of red cell formation. They were also able to show that this type of training was successful at increasing endurance performance.

"We have used IHT in Christchurch since 1999 with good success," says Dr Hellemans.

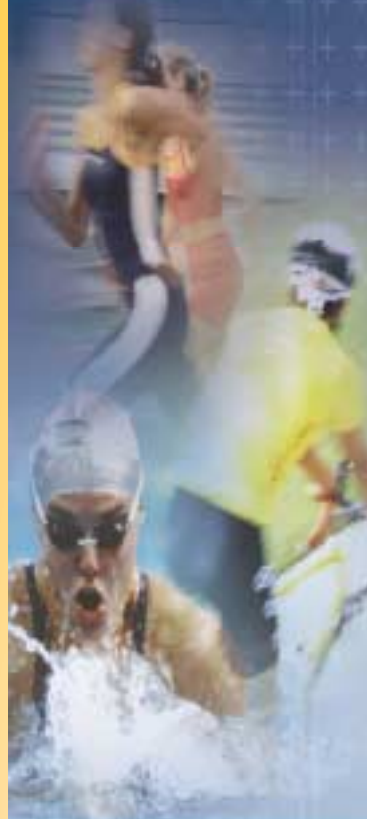
"It is used not only by athletes to improve endurance but also by mountaineers and high altitude trekkers to acclimatize before arriving at altitude.

"There is now convincing evidence that IHT is an effective and convenient tool for acclimatization, thereby reducing the chance of altitude sickness greatly.

"IHT is also effective as a complementary treatment for chronic illness, in particular heart disease, fatigue and asthma. IHT has a similar effect on bodily functions as exercise and can therefore be used for treatment and prevention."

Dr Hamlin says that while it seems that red cell production probably plays a part in the performance enhancements found with this type of training, other mechanisms are undoubtedly at work and he and Dr Hellemans are keen to conduct further research in this field.

Nous disposons de l'ergomètre le plus performant : **CompuTrainer™**



Étude faite pour l'École de ski et d'alpinisme, France (July 2004, Clermont-Ferrand, France)

Living high- training low : effect on red cell mass and aerobic performance in elite middle-distance runners

Robach Paul, Brugniaux Julien V, Schmitt Laurent, Nicolet Gerard, Fouillot Jean-Pierre, Lasne Françoise, Moutereau Stéphane, Olsen Niels V, Richalet Jean-Paul

The present study indicates that 18 days of living high- training low induced a net increase of 5% in aerobic performance, which tended to persist 15days after the end of training. In the present study, erythropoiesis was slightly stimulated by hypoxia, as showed by the increase in sTfR and the decrease in ferritin, even if the other haematological parameters did not markedly change. The present data therefore suggest that, besides haematological changes, living high training low may also enhance aerobic performance through other processes.

**LIVING HIGH AND TRAINING LOW**

Training at high altitudes has been popular among runners since the 1968 Olympics in Mexico City. From the results of those Games it was obvious that to compete well at high altitude it is necessary to train at high altitude. It is not clear, however, whether training at altitude provides an advantage for competitions at sea level. The few well-controlled studies have found mixed results when athletes train at altitude to prepare for sea level races. Yet, places such as Boulder, Colorado, and Albuquerque, New Mexico are practically shoulder-to-shoulder with world-class athletes and wannabes seeking the high altitude edge. Let's take a look at the physiological effects of altitude training and the latest ideas on how to improve your performance with high altitude.

The primary benefit of altitude training is an increase in the natural production of the hormone erythropoietin (EPO), which increases the hemoglobin content of your blood. Oxygen is transported in your blood attached to hemoglobin

An increase in EPO, therefore, leads to an increase in the oxygen carrying capacity of your blood, which lets more oxygen reach your muscles allowing you to maintain a faster pace.

In this way, your body increases red blood cell production, but you are able to maintain high intensity training. Several recent studies have found performance benefits from the live high/train low method. The problem with living high and training low, however, is that it can be a logistical nightmare. There are only a few places in the world where you can live at a high altitude and quickly drive down to low altitude to work out. Sensing a potential market, entrepreneurs have recently developed a variety of ingenious altitude simulators that "bring the mountain to you" by creating artificial high altitude environments.

There are at least 5 different altitude simulators currently available, which fall into 3 categories (see table below). Nitrogen houses are complete living areas sealed off and brought to a low oxygen concentration. You live and sleep in these houses, and train outside at sea level. Altitude tents are a less-expensive and more portable alternative, in which you set up a sealed tent over a standard bed and sleep at simulated high altitude. Both of these methods mimic the live high and train low scenario.

Another option is the hypoxic (low oxygen) training chamber. This is a sealed room in which you work out at simulated high altitude. Hypoxic chambers are springing up in fitness centers around the U.S. This system is really the opposite of live high and train low in that you train at simulated altitude and live at sea level. This runs counter to the popular hypothesis that the gains in red cell mass are realized by simply living at altitude while performance gains require high intensity training. Here at the lab, we tested a hypoxic chamber for 3 weeks. We put in a rowing machine and a turbotrainer, and cranked it up to 8,000 feet. With air conditioning and a humidifier, training in the chamber was quite comfortable, but also boring as hell. The final alternative to increase red blood cell count through altitude simulation is "intermittent hypoxic training" or high altitude intervals.

*This column originally appeared in [Running Times Magazine.](#)*

Altitude Simulators		
Type	Method	Scenario
Nitrogen House	Live and sleep at high altitude	Live High/Train Low
Altitude Tent	Sleep at high altitude	Live High/Train Low
Hypoxic Chamber	High altitude training in sealed room	Live Low/Train High
Hypoxicator	Intermittent breathing at very high altitude	Live Very High and Low/Train Low