

Nutrition and Metabolism for British Army Everest West Ridge 2006

Introduction

A balanced diet that provides sufficient energy will be vital to maintaining physical and mental performance during the EWR 2006 expedition. In addition it will have an important role to play in maintaining morale and motivation. Jude Humphreys, the EWR food manager, and Louise Sutton, Principal Lecturer Leeds Met Carnegie, have combined their skills and knowledge in an attempt to provide the teams with nutritious meals and traditional snacks taking account the likelihood of menu fatigue, and where possible, individual preferences. These meals and snacks will be supplemented by low and high altitude energy bars that have been specially developed for the expedition by Professor Rod King from the Carnegie Research Institute, and in conjunction with the Global Science Centre for Cadbury Schweppes. These bars have been formulated using specific ingredients to deliver the nutritional requirements for such a strenuous challenge, in addition an Energy Drink formulation will assist the team in meeting their overall energy requirements as well as contributing to fluid needs. Complan meal replacement products have also been selected for their potential to assist in meeting micronutrient requirements during an expedition of this duration.

During the expedition team members will be participating in research into the influence of diet and energy expenditure on body composition and wellbeing at extreme altitude by providing information on dietary intakes reported via diet diaries. It is anticipated that the findings of this research will form the foundation and evidence base of future education for subsequent high altitude expeditions. In preparation for this task the teams have been keeping diet diaries whilst away at training camps in Peru, the Alps, and in the final 3 month lead-up to the expedition to familiarise themselves with the process and to use the feedback on nutritional intakes to support their physical training schedules.

Energy Requirements and Nutrient Balance

The evidence for the impact of a balanced diet on physical performance is well recognized, but eating the right diet can enhance mental performance too. The main fuel for the brain is glucose and sound mental performance relies upon maintaining an adequate blood glucose concentration. If blood glucose levels fall to values outside normal limits cognitive function will be impaired resulting in problems with attention, memory and vigilance. Adequate and frequent carbohydrate intakes are important to the maintenance of blood glucose.

It is obvious that increased energy intakes are required at high altitude, energy requirements being in the range of 5000 to 6000 calories per day; but this places an even greater importance on the achievement of adequate carbohydrate intakes, preferably 60-70 per cent of total energy intake. As oxygen levels decline adequate carbohydrate intakes become vital

as they are a more efficient fuel source than either fat or protein for meeting energy demands. Increased altitude also has the potential to suppress appetite and alter taste sensation, all conspiring to making meeting nutritional requirements a difficult task, with weight loss at altitude appearing inevitable. In short, it is predicted that energy requirements at Base Camp will be near double resting metabolic requirements at sea level, beyond Base Camp a tripling of resting metabolic requirements is predicted.

Environmental Effects

Place a person in a different environment and realise that adaptations may be necessary for normal function. Place that person at altitude and superimpose a harsh climate and those adaptations are seriously challenged. What capacity there exists for evolved response is limited because these systems have been acquired by evolution under more temperate and modest conditions. At the extreme, responses to oxygen availability, the need to maintain body temperature, the acquisition, digestion and assimilation of food and in short whole body physiology, metabolism and nutrition are at their limit. Survival becomes the only dominant activity of significance yet human endurance and persistence, despite the odds, is of fundamental necessity.

Nutritional Challenges

To successfully ascend Everest the human system has to be maintained in such a condition that all energy demands are met to complete the climb without significant and permanent damage to the body. Intrinsic adaptations to hypoxia are well evolved but those relating to fuel supplies for energy provisions in such a harsh environment where temperatures range to – 40°C are not so. The fundamental challenge metabolically is to provide adequate nutrition in situations where normal eating patterns are seriously compromised, where appetite has changed, where energy demands whilst climbing are almost insatiable and where food provision is affected by the climate and location. The goal of sustained energy provision without any loss of body mass or lean tissue is probably unaccomplishable. However, careful consideration of nutrient choice and timing of nutrient provision during all stages of the climb presents a practical and potentially useful way of ensuring that erosion of the human body and depletion of energy reserves is limited, at least sufficiently to attain the goals of the expedition without irreversible damage to health. Existing research and evidence base for this sort of functioning is scarce, influenced in part by the sheer difficulty of gathering data in a field situation where the ability to control experiments and test hypotheses is fraught due to the environmental problems of climate and altitude.

If expeditions such as EWR 2006 are to succeed, then nutritional strategies that address the energy demands whilst climbing, but also that of recovery at the end of each climbing period are paramount. Previous studies report losses of body mass up to 20 per cent, with significant

contributions made by losses in lean body mass. Loss of lean body occurs due to energy demand exceeding energy supply at critical periods during the climb. During such periods the body supplies fuels for energy not only from glycogen and fat reserves but any shortfall will be made up from protein; hence the loss of lean tissue. This sacrificial loss of protein will also occur if daily energy intake and nitrogen balance are not maintained at rest periods, especially after each climbing period when recovery for the next climbing period ought to be the sole activity.

In addition to increased energy requirements, increasing altitude brings an increasing risk of dehydration due to diuresis, water lost in breath and sweat, as well as difficulty in obtaining adequate water. High fluid intakes will be required, up to 5-6 litres per day.

Research Objectives

The focus of nutrition research to this expedition relates to the ways in which energy and macronutrient consumption can be maximised and maintained throughout the expedition. This extends to the ways in which nutrition is prescribed and compliance achieved, along with the acceptability, palatability and efficacy of nutritional products and strategies; and to the best way that performance and health can be matched to decrease specific risk yet allow attainment of the primary objective of summiting. Diet is the only practical method to help preserve the lean body, replenish glycogen stores, maintain body weight and sustain mental ability, physical fitness and endurance.

The research that is necessary and being undertaken includes as complete an assessment as possible of dietary provision and nutritional intake for the army team engaged in the EWR 2006 expedition from Base Camp to Summit and return. This is effected by the use of several dietary analysis techniques including the use by team members of diet diaries, diet recall and group interrogation at key points and specific stages of the ascent. Pre-expedition identification, acquisition and supply of nutrients has enabled shipment to be made of ration packs tailored exactly for all stages of the expedition from the journey in to Base Camp to the Summit bid. Evaluation of likely energy and macronutrient needs for the team and its individual members was a key driver for selection, trial and prescribed use of the full range and types of provisions used. Further, specific and novel nutritional ingredient mixes were formulated by the Carnegie Research Institute and Reading Scientific Services, Cadbury Schweppes, for identified needs whilst climbing at altitude that were not possible by existing proprietary products.

Specialist Products

Climbers are not easily able to prepare and use conventional foods during active climbing but it is proposed that they would be able to ingest a completely formulated macronutrient product

provided that it is readily accessible by package design. To meet the climbers' energy demands pre-expedition research indicated a need for a solid as well as a liquid product to assist in meeting overall energy demands. Two types of product have been developed specifically to address the need to maintain energy balance and preserve lean body mass whilst climbing at altitude during the EWR 2006 expedition. One product is formulated as a cereal bar to be eaten whole, the other as an energy powder to be drunk after mixing with water.

The cereal bar product underwent development for two basic requirements, one for cold temperature consumer use and the other for nutritional composition. In the event it was found possible to provide two varieties of bar, "Enhanced Bars" with low glycaemic index but with full macronutrient combination of fat, protein and carbohydrate for use at lower altitudes on Everest, and "All the Way Bars" of higher glycaemic index having additional features specifically for high, cold altitudes by virtue of a low glass point of $-19\text{ }^{\circ}\text{C}$. These bars can be eaten at cold temperatures with reduced problem of biting and chewing. "All the way Bars" were designed and tested for use at extreme altitude to provide wholesome nutrition whilst actively climbing, with provision as smaller multi-pack mini-bars as well as a 40g bar for specific types of active climbing. "Enhanced Bars" were designed and tested for use at lower altitudes and especially as a supplement to be consumed whilst camped at Base Camp and at the end of climbing sessions, provided as 75g bars of either "fruit" or "nut" types.

The Energy Powder similarly underwent development for two basic requirements, one for ease of solution to be prepared with hot water from melted snow, the other to provide a nutritionally complete macronutrient blend with protein, fat and carbohydrate together with specified vitamins and minerals. It was possible to formulate this powder both as a *recovery* preparation mixed at full strength and as an *active use* preparation mixed at half strength. The recovery powder was designed and tested to formulate into a solution without congealing when mixed with water at $70\text{ }^{\circ}\text{C}$.

A key part of the nutrition provision and research concerns these novel products. Full monitoring of their use by the teams during key stages of the expedition, such as initial exposure to altitude, key gains in altitude and preparation for Summit bids, will enable evaluation of efficacy and performance by product, along with justification of approach and use, consolidation of existing dietary provision and will also allow by feedback and evaluation of performance, future development needs and specification of such products.

Summary

The supply and provision of well-designed products based on sound scientific platforms underpins the dietary provision of expeditions of this kind. Along with careful attention to the basics of meeting nutritional requirements, such as catering for taste preferences and menu

fatigue; and ultimately the availability of sufficient food supplies, together with other physiological and psychological support such work is essential to facilitate safe and successful expeditions.