

NUTRITION FOR MILITARY FITNESS

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Abstract. The application of new knowledge in food science and nutrition is important in ensuring that Service members are in peak physical and mental condition for warfighting. The Defence Nutrition Research Centre of the Australian Defence Science and Technology Organisation has conducted extensive research and development to determine the nutritional requirements of Australian Defence Force occupations. In this paper, three aspects of this research are discussed. *Determining and Satisfying Nutritional Requirements:* Mean daily energy expenditure of Australian Defence Force (ADF) members varied from 12 MJ (sedentary occupations) to 28 MJ (Special Forces selection) per man. New ration scales and ration packs have been devised to satisfy demonstrated nutritional needs. *Hydration Requirements:* Sweat rates of 1.0-1.5 L/h were found during infantry operations in hot/wet and hot/dry environments. An investigation of the value of a new system of water carriage and delivery in encouraging water intake found significant benefits, and no decrements associated with the new system. *Ergogenic Aids:* Some substances and techniques that enhance athletic performance ('ergogenic aids') show potential as aids to military performance. International co-operative and collaborative R&D is continuing on the safe and effective use of ergogenic aids in the military context.

INTRODUCTION

Few people would be aware that one of the more significant recent applications of science and technology to military operations was the invention of food canning. Nicholas Appert - a French inventor of the early 19th Century - was awarded a substantial prize by Napoleon Bonaparte for inventing the canning process. This is because the availability of canned food allowed the French Army to march long distances, carrying their own food, rather than having to rely on finding food along the way. One result of this was greater mobility, often allowing Napoleon's Army to reach the battlefield ahead of the enemy, engage in surprise attacks and to be frequently in better physical condition than the enemy. Although it does not command the same headlines as the acquisition of military platforms such as Collins Class submarines, FA-18 Hornet fighters or new tanks, research and development (R&D) into food and nutrition is still considered to be vital today in helping to 'bring out the best' in Australian Defence Force (ADF) members. Of the major focus areas that are being subjected to intense scientific R&D - *lethality, sustainability, mobility* - the potential for beneficial impact from the application of new knowledge in food science is greatest in the area of *sustainability* of operations.

All Australian R&D on military aspects of food science is conducted by the Defence Science and Technology Organisation (DSTO) at its Defence Nutrition Research Centre (DNRC). This is a small laboratory tucked away among the green and lush pastures of rural northern Tasmania. DNRC is a laboratory of DSTO's Combatant Protection and Nutrition Branch (CPNB). DNRC exists to determine the nutritional requirements of members of the ADF and to ensure that ADF feeding systems keep our soldiers, sailors and airmen literally 'fighting fit'.

DETERMINING AND MEETING NUTRITIONAL REQUIREMENTS

Energy Expenditure Studies -Army

Using a state-of-the-art technique (based on the stable isotopes deuterium and oxygen-18), we have determined the energy expended by soldiers across a wide range of military activities. Because females are not permitted in direct combat

positions such as infantry, these studies involved mainly male soldiers. Energy expenditure levels varied from a mean of 12 megajoules (MJ) per man per day for sedentary soldiers (engaged in a clerical course) to 28 MJ/day for soldiers attempting selection to the Special Air Service Regiment (SASR). Soldiers engaged in typical field exercises had mean expenditure of approximately 15 MJ/day; Army recruits expended ~16 MJ/day; while training for jungle warfare led to a mean daily expenditure of ~19 MJ. The energy cost of parachute training was surprisingly high; at nearly 17 MJ/day it was greater than the energy expended by Army recruits despite a seemingly lower physical workload on the part of the parachutists. We speculated that the stress of taking part in a potentially life-threatening activity may have led to increased metabolic rate and hence to greater energy expenditure.

Meeting Demonstrated Nutritional Needs

From these results we categorised military activities into five levels according to energy expenditure. The results were also used to determine 'Recommended Military Dietary Intakes' (RMDI). The RMDI are the levels of energy and essential nutrients that are recommended for each of the five categories of military activities. Four tables of RMDI were determined, one for each of the following groups of ADF members: Servicemen, Servicewomen, Adolescent (16-18 years) Servicemen, and Adolescent (16-18 years) Servicewomen. Table 1 shows representative military activities and the RMDI for energy for two of the groups (Servicemen and Servicewomen) for each of the five categories.

In addition to total energy and essential nutrients, the mix of protein, fat and carbohydrate in the soldier's diet is important in ensuring that nutritional status promotes optimal military performance. Because carbohydrate is the preferred fuel for muscular work, soldiers' rations should be high in carbohydrate and relatively low in fat. However, this must be balanced against the requirement to minimise weight and bulk of rations, particularly in light of Australia's continuing emphasis on land operations involving foot soldiers carrying heavy loads. The Army's soldier modernisation program (Project 'Wundurra' - an Aboriginal word for 'warrior') also has the potential to impact on soldier *mobility* (another focus area). Soldiers in the 'enhanced' condition were each carrying more than 40 kg of equipment at the 1998 Soldier Combat