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A Qualitative Evaluation of Several Ration Concepts in a Field Setting

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ABSTRACT

Increasingly demanding and varying operational situations, combined with under-consumption of ration pack items, questions the suitability of current CRP for modern military operations. A project was thus undertaken to explore alternative ration pack configurations and to elicit the views of military personnel likely to use them. Six ration concepts were developed; two lightweight options, two whole-day options; and a modular option. A qualitative evaluation of these ration concepts revealed that four were considered promising and worthy of further development. Three broad courses of action were also identified—improving the current CR1M, introducing lightweight options and developing modular rations. It is recommended that:

- the merits of each of these actions be investigated; and
- a case be developed for each of these options to be pursued in series—progressing from improvements to the existing CR1M, to the introduction of light-weight options (which may become modules), then finally to modular rations.

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A Qualitative Evaluation of Several Ration Concepts in a Field Setting

Executive Summary

Australian Defence Force (ADF) personnel on operations rarely consume all items in the combat ration packs (CRP) supplied. This under-consumption, together with a range of increasingly diverse and less predictable operational situations being experienced by ADF members has raised doubts about the suitability of CRP when used as the sole source of nutrition for personnel deployed on ADF operations. Consequently, we undertook studies to identify potential solutions for future combat rationing of the ADF.

A three-step process was used in the project—user input before design (both stakeholders and users were included), concept design, and user evaluation of options developed. For such an evaluation qualitative data was collected to explore user perspectives of current CRP and their views as to the potential of the alternative configuration options presented.

Pre-design input indicated users and stakeholders felt there was a need for more flexible options that could cater for a wider variety of situations. Alternative ration configurations could reduce the selective use of items in the current ration packs, which commonly occurs, and the consequent under-consumption leading to nutritional requirements not being met. Factors of importance to users and stakeholders were: variety, compactness, convenience and ease of use. The inclusion of energy-dense foods, comfort foods, recovery foods, and commercial sports products was considered important. Retort meals continued to be a cause for complaint, whereas freeze-dried meals were well received. Users expressed the need for nutrition education and instruction on the use of CRP. Finally, users and stakeholders accepted that cost, logistics, and flexible design all pose challenges for future CRP design and development.

Six ration pack options were developed; two lightweight options, two whole-day options; and a modular option. A qualitative evaluation revealed that four of these were considered promising and worthy of further development; the Part Day Ration (PDR), the light Weight Ration (LWR), the Whole-Day, Meal-Based Ration (WD-MB), and the Modular Energy System Ration (MES).

From this evaluation it was concluded that there were three possible courses of action—improve the existing CR1M; introduce light-weight rations; or develop a modular rationing system. These three courses of action could be pursued sequentially.

It is recommended that:

- the merits of each of three courses of action be considered in light of current knowledge of military nutritional requirements, food science, cost, logistics, change management and other constraints; and

- a case be developed for each of these options to be pursued in series—progressing from improvements to the existing CR1M, to the introduction of light-weight options (which may become modules), then finally to modular rations.

These recommended courses of action are likely to alleviate the current problems associated with CRP. There is the potential to produce a suite of rations which are more suited to ADF requirements and therefore better utilised by ADF members.

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1. Introduction

Australian Defence Force (ADF) members rarely consume all items provided in the combat ration packs (CRP). In many cases they do not consume sufficient items in their ration packs to balance energy intake with energy expenditure [1-5]. As a result, the majority of troops who are rationed with CRP lose weight. This under-consumption, and the resulting energy imbalance, is associated with an increased risk of decline in both physical and cognitive performance.

Recently the ADF has faced operational situations outside the scope of the current suite of CRP. This includes extended operations away from a support base, operations at high altitude and those in extreme climatic conditions (operating in both hot and cold temperatures).

The problem of CRP under-consumption raises doubts about their suitability for use as the sole source of nutrition for ADF members, particularly in new operational and physical environments that may be outside the original scope for use of CRP. It was thus decided to identify a range of CRP options that could, potentially, satisfy new and increasingly demanding operational environments and then evaluate the suitability of the options identified.

To ensure that a representative and manageable set of options were generated that would also be acceptable to military users; the key stakeholders for CRP provisioning were consulted. In light of this, the approach was focused to develop concepts for CRP that would assist in overcoming specific problems that are known to occur when rationing of ADF members is solely by CRP.

1.1 Approach

The approach aimed to gather information from stakeholders about requirements for CRP, and known or anticipated shortfalls. Information would then be sought from users about activities, CRP usage, perceived positive and negative features of CRP, and suggestions for improvements. These results were then used to build concept ration packs, and guide the evaluation of these packs in field settings.

This report describes the information gathered from stakeholders and users; details the concepts that were developed; records the process used to evaluate those concepts; and discusses the results of the evaluations. Future directions for this work are also suggested.

2. Methods

2.1 Overview

A three-step process was used in the project—user input before design (both stakeholders and users), concept design and user evaluation of concepts. Input into the design of concept rations was obtained through a stakeholder workshop, followed by focus groups with end-

users (i.e. ADF members who are commonly rationed with CRP). Once concepts had been developed they were taken into a field situation where they were evaluated by end-users, again in a focus group setting. This methodology was chosen after consideration of the nature of the field exercise which imposed constraints that would not allow for an extensive experimental evaluation involving many users.

2.2 Stakeholder Input

The workshop was held in December 2009 with representatives attending from Joint Logistics Command – Strategic Logistics Branch (JLC SLB), Forces Command (FORCOMD), Defence Material Organisation (DMO), Joint Health Command (JHC), Headquarters Australian Army Cadets (HQ AAC) and Defence Science and Technology Organisation (DSTO). Other stakeholder groups identified but not in attendance were Navy Headquarters (NHQ), Air Force Headquarters (AFHQ) and Joint Operations Command (JOC).

A discussion template was used to ensure that the following issues were covered:

- Current and future requirements for CRP (including technological and operational drivers, user requirements, and situational issues).
- Capability gaps with the current suite of CRP (including discussions of known failings of current CRP).
- Freedoms and constraints to consider when addressing these gaps (including discussion of when it is envisaged CRP should be used, under what circumstances, and issues with re-supply, storage, logistics and load carriage).
- Future directions.

2.3 User Input

The data collection plan was devised to obtain user input across a range of user groups. Six focus groups were held, three with soldiers from units based at Holsworthy Barracks in Sydney, and three with soldiers from SASR in Perth.

At each site the participants consisted of Sub-unit/Unit Commanders (Group 1); Catering staff/Supply staff (Group 2); and end-user soldiers (Group 3). All three focus groups were conducted using a questioning route that followed the guidelines of Krueger & Casey [6], and were run by the same moderator. Questions were open-ended, with general questions transitioning to specific questions; positive questions before negative ones; and un-cued questions before cued questions. The technique relies on the creation of a comfortable environment for participants, which leads to voluntary disclosure of opinions/ ideas/thoughts, and the synergistic influence of the group draws more information than would be gained from an individual alone.

A questioning route was devised for each group to gather information about:

- How CRP are used in the field

- The types of situations/activities in which CRP are used
- The positive and negative features of current CRP
- The barriers and promoters of CRP consumption and design
- Suggested new CRP designs and items.

Most key questions were repeated in all three groups for comparison, however each group had some unique key questions (for example, Unit Commanders had a question on planning, Catering/Supply staff had a question on supply issues, and end-users had questions relating to usual usage of CRP). Each focus group ran for 1.0–1.5 hours.

Abridged transcripts were then created and systematically analysed following the methods described by Krueger & Casey [6]. Comments were categorised into seven major themes:

- What happens
- Supply
- Positive aspects of CRP
- Negative aspects of CRP
- Perceived barriers to improved CRP design
- Perceived promoters of CRP design
- Other suggestions.

2.4 Nutritional Guidance

Nutritional goals were set for concept combat rations based on existing guidance from policy documentation [7, 8], and adapted using more recent nutritional guidance [9].

Currently, the two most commonly used CRP are the Combat Ration One Man (CR1M) and the Patrol Ration One Man (PR1M). The CR1M is required to have an average energy value of approximately 15 000 kJ and has a weight of approximately 1.9 kg, whereas the PR1M is required to provide an average energy value of approximately 14 100 kJ and have a weight of approximately 1.0 kg [8].

Forbes-Ewan [9] recommended that general purpose ration packs should be designed for ADF members working at an activity level of Category 3 ('very active') and provided a table of recommended nutritional criteria for a general purpose ration pack. The requirements and recommendations for CRP are compared with our goals for concept rations in Table 1.

Table 1 Nutritional Guidance for existing CRP, recommended for a General Purpose Ration Pack, and for Concept Rations

	Energy (kJ)	Protein (g or %)	Fat (g or %)	Carbohydrate (g or %)
User Requirements [8]				
CR1M	15 000	NS	NS	NS
PR1M	14 100	NS	NS	NS
Recommended for a general purpose pack [9]	16 000	122–150 (13–16%)*	108–143 (25–33%)*	565–590 (57–59%)*
Concept rations				
Whole day	16 000	15%	25%	60%
Light weight	7 500	13%	25%	62%
Part day	5 000	15%	25%	60%

Notes:

** % is the recommended percentage contribution by each macronutrient (protein, fat and carbohydrate) to total energy (shown as a range in each case).*

NS = not specified

2.5 The Concept Rations

Six concept rations were developed following analysis of the input from stakeholders and end-users. They were:

- Part Day Ration (PDR)
- Light Weight Ration (LWR)
- Whole Day – Meal Based Ration (WD-MB)
- Snack Based ration, Hand-to-Mouth (SB-H2M)
- Snack Based ration, Minimal Preparation (SB-MP)
- Modular Energy System Ration (MES).

The rationale for each proposed CRP is discussed below in Section 3.3. The menus for each concept ration are shown in Appendix A. The names for these concepts should be regarded as 'working titles'; more appropriate and succinct titles may be required should these concepts be introduced into service.

2.6 The Evaluation

The concept rations were evaluated by soldiers during Exercise Hamel in October 2010. The method of evaluation was determined after consideration of the lead time available for concept ration preparation and the anticipated period of access to soldiers during the exercise.

Soldiers gathered at a central point during the exercise after being rationed with CR1M for three weeks. At this point they were able to eat a freshly prepared meal, shower, and have a short break before returning to the field for another extended period where rationing was by

CRP. Each platoon was at the central point for approximately four hours, and three groups (approximately 300 soldiers in each group) passed through the central point each day in a staggered manner.

Focus group participants were recruited to the study (on a voluntary basis) as they passed through the central point. Twelve focus groups were conducted over two days. Three moderators led the focus groups, with the same questioning route being used by each moderator to ensure a consistent evaluation of all concept rations. The questioning route focussed on the following: the perceived usefulness of the concept for certain situations; the suitability of the concept ration and of the combination of items within that ration; and the positive and negative perceptions of the individual items within each concept ration.

3. Results

3.1 Stakeholder input

At the initial stakeholder workshop in Canberra a number of requirements for CRP were identified for specific groups, units or services, for which there were no obvious solutions. They were:

- Asylum seekers or unlawful entries on board vessels
- Diving parties
- Boarding parties
- Disaster relief (for affected civilians)
- Cadets
- Part-day rations (rationing for less than 24 hours).

Clarification of the need for each of these was requested, and it was acknowledged that this list is unlikely to be exhaustive.

The discussion of the current issues with CRP was centred on the high level of ration pack items being discarded, due to a tendency to retain attractive and convenient items, and to supplement with additional items ('jack rations'). Stakeholders suggested two ways in which CRP usage may be improved—educating troops on how to prepare and use CRP, conducting further R&D to identify (or develop) items that are acceptable, increase variety and ensure satiety.

It was acknowledged that the total weight and packaging of CRP contribute to load carriage, but the extent of this problem is not well defined. Contributing to this are recent changes to how personnel travel (e.g. a move away from dismounted towards mounted transport) and operate (environment, tempo and mode of operation).

3.2 User input

Discussion in each of the focus groups was lively, with all participants volunteering their opinions. When considering these findings it should be remembered that the perceptions of some participants may not apply equally to other situations or individuals. Consideration of all of these perceptions provides valuable understanding and insight into how soldiers use CRP, and offers opportunities to improve products, ration packs and rationing practices to enable better usage of this resource.

Responses from the six focus groups were categorised into seven themes, and each will be discussed in turn. A summary of issues is provided, followed by some interpretive comments.

3.2.1 'What happens?'

As expected, the activities and situations experienced by soldiers eating CRP varied greatly. The level of activity can range from *arduous* to *static/sedentary*, and the climate can range from *extremely hot* to *cold*.

> **Comment:** There are gaps in DSTO's knowledge of the nutritional requirements across the range of ADF activities and working environments, mainly because information on the details of the activities and environments is not readily available. CRP design will need to cater for a wide range of demands. Some operational scenarios may be best addressed by tolerating a nutritional deficit over the short-term, and providing a subsequent fresh feeding recovery period. Tailoring CRP to every situation is not expected to be a viable solution. Flexible options that cater to a variety of situations would provide more practical solutions.

Commanders reported that they plan for fresh feeding to be made available as soon as possible (where situations allow for it to be provided), and that they incorporate CRP into their plans to cover the period when field kitchens are being set up and dismantled.

> **Comment:** Consistent with the practice reported by Commanders, current policy dictates that they should plan for fresh feeding to be made available as often as possible (where situations allow for it to be provided). Policy also states that rationing with CRP should only cover the period when field kitchens are being set up or dismantled, or where fresh feeding is out of the question for operational or environmental reasons [10].

However, many soldiers perceived that CRP are sometimes used as an easy option (i.e. easier than setting up field kitchens and providing fresh food), or that the setting of a maximum period for feeding with CRP means they may (and therefore will) be used for that period before fresh feeding is required to be provided. There was concern that some units no longer have catering staff, and the ability to transition to fresh rations is being lost.

Soldiers reported that they had spent long periods eating CRP as their main source of food. Periods of three weeks, four weeks and six weeks were often mentioned, mostly on deployments, but also during field training. Although it was acknowledged that there would

be times when this is unavoidable, many thought that some periods spent on CRP were unnecessarily long.

> **Comment:** Efforts are being made within Army to ensure that access to fresh feeding as soon as possible—or at least having ration pack feeding broken up with the occasional fresh meal—is standard practice. Policy states that CR1M should be issued for no more than 16 days in non-operational situations [10]. These efforts need to be sustained and supported, to enhance soldier morale and ensure optimal health.

CRP (especially the CR1M) were reported to be used at times to provide a single meal, in conjunction with fresh feeding. When fresh meals were provided for breakfast or dinner (sometimes both), a CR1M would be issued to provide the other meal(s). This created a great deal of wastage, as a full ration was provided, but only a few items were used. This was reported to occur in some static situations, when patrolling short distances from a base, or when moving between bases.

> **Comment:** There may be value in the construction of a part-day or single-meal ration for situations where some fresh feeding is available, or when soldiers are on the move for short periods of time.

Soldiers reported that after eating CRP for long periods they tended to eat less over time, often losing their appetite and becoming bored with the same types of foods every day. Preparation time was often limited, but even when adequate time was available most soldiers did not bother to use the items that needed preparation. Many reported living off the CRP snack items and jack rations, or other supplementary items available to them. It was recognised that soldiers who are working extremely hard must make a conscious effort to eat enough food to maintain strength and muscular endurance. Several soldiers noted that it is difficult to eat a large amount of food immediately after completing a physically demanding task, and suggested that high-energy drinks (e.g. shakes)[1] may be valuable at such times.

> **Comment:** The need for greater variety and more convenience items is evident. Easy-to-prepare shakes may be a worthwhile addition to CRP.

The lack of time available to prepare items was often mentioned. It was considered necessary to include items with very little preparation that can be eaten cold. Some questioned the need to even include the hexamine heating device as it takes up space, is rarely used and cannot be used in situations where visible flames are not permitted.

> **Comment:** It is essential to provide items that can be eaten cold and with minimal or no preparation.

Stripping of CRP was raised a number of times. Some soldiers simply discard items they do not use, while others go to extreme lengths to repack items in a manner that makes access easier. For example, meals may be packed together in the backpack, with snacks being kept on

[1] Shakes are powdered drinks high in energy. They require the addition of water, and reconstitute when shaken, producing a drink similar to a milkshake.

the person, perhaps in a pocket for ease of access while on the move. Soldiers noted that more ziplock bags would facilitate this.

> **Comment:** Alternative configurations may reduce the need to strip rations as aggressively as occurs now. A suitable configuration could be modules of meals, snacks, drinks and extra items.

It was noted that it is difficult to balance the desire for dehydrated (and light) items and the need to carry water. It is now common to be working in drier environments that may not have water readily obtainable in the field, and many soldiers spoke of moving away from the previously preferred PR1M to the CR1M due to the added burden of water carriage when rationed with PR1M.

> **Comment:** Consideration may be given to configurations that contain both dehydrated meals and retort meals.

3.2.2 Supply

Issues created by the supply system were discussed. Those working within the system were using it as well as they could, but getting a variety of CRP menus to soldiers was a common problem. Often only a few menus were available from the distribution centre. The current method of packing ten of the same menu in a box (and then boxes of that same menu on a pallet) means that variety is not inherent in the system, and units would often receive only the one menu for the entire period of CRP feeding. Concern was expressed about the long time that CRP are kept in storage, and the effect this has on both nutritional quality and acceptability. The practice of newer ration stock leaving the warehouse ahead of older stock was also criticised (last in first out, as opposed to first in first out).

> **Comment:** Consideration should be given to packing a variety of menus in each box. DSTO is involved in a research project examining the logistics/supply system to identify weaknesses and suggest improvements.

3.2.3 Positive aspects of CRP

It was acknowledged that although CRP do not compare favourably with fresh food, in terms of nutritional content or acceptability, they are a reasonable substitute for short periods. Most soldiers have a working approach to breaking down CRP, retaining items they like and complementing the ration pack food with whatever supplements they can obtain, e.g. from US Meals-Ready-to-Eat (MREs), military-provided supplementary foods, or jack rations.

The freeze-dried meals (or 'dehydes' as they are commonly called) were considered by some soldiers to be superior to, and more filling than the retort meals, even with the added burden of water carriage previously mentioned. The larger size freeze-dried meal (110 g) was preferred to the smaller meal (75 g — which has now been discontinued, but was still remembered by some participants). Chicken Tetrazzini and Tuna Mornay were mentioned as popular freeze-dried meals.

Retort meals were considered to be of sufficient size and convenient as no water needs to be added. However, not all were considered to be acceptable – including Beef Stroganoff, Chicken Italiano, Spaghetti Bolognaise, BBQ Beef, BBQ Chicken and Roast Beef and Gravy.

> **Comment:** Freeze-dried meals should be considered for use in a number of ration configurations as they are well liked. This needs to be balanced with the added burden of water carriage.

Soldiers were asked to name ration pack items that were popular and regularly consumed. They stated that anything that was considered easy and convenient to eat or pack—such as snacks and items requiring minimal or no preparation—was likely to be consumed. Items specifically nominated were tuna, M&Ms, fruit grains, main meals, chocolate, muesli, cracked pepper Vita-Weats (crispbread biscuit), condensed milk, canned fruit, muesli bars, rice, biscuits and lollies. Disappointment was expressed at the removal of M&Ms, Shrewsberry biscuits and the chocolate spread. Rice and muesli were valued, but usage depended on available preparation time. Rice usage was also reliant on what was available to use or mix with it.

> **Comment:** Convenience and ease of use continue to be the main features that soldiers look for in CRP items. Popular items should be retained where possible.

3.2.4 Negative aspects of CRP

Soldiers recognised that eating the same types of foods continuously was certain to reduce their desire for those foods. They commented that the lack of menu variety at the point of issue exacerbated this problem.

> **Comment:** It is important to maximise variety within menus and between menus in CRP, and to devise a CRP supply system that maximises variety in the field.

The quality of the items was perceived to be inferior, especially the retort meals. Most soldiers considered them inedible because of the presence of visible fat, gristle, blood vessels and connective tissue in the majority of meat-based meals. This has been a longstanding complaint with these meals, and many soldiers would not even open the retort pouches to consider eating the meals, as they make the assumption of poor quality based on previous experience. Many retort meal varieties were also considered to be inedible when cold, rendering them useless in those situations where heating food is not an option.

> **Comment:** The problems with the quality of meat in retort meals are well known, and have been known for quite some time. This needs to be addressed. The firmly entrenched expectation that retort meals are inedible is a concern, as it can be very difficult to change expectations that have been reinforced over many years.

The nutritional quality of CRP was also perceived to be substandard. CRP were considered to contain items that are high in sugar, and do not provide the long-lasting energy required. Readily available commercial sports bars were reported to be common jack rations, and in comparison offered more than current ration items such as biscuits and muesli bars. Soldiers consider that the work they do is physically demanding, and as such they feel that foods

produced for the sporting community are relevant to them, and should be included in ration packs.

Comment: Investigation of sports foods for inclusion in CRP is warranted.

Most soldiers commented about the amount of wastage produced after soldiers had stripped their combat rations. Wastage also occurs when CRP are transported north of the Tropic of Capricorn—any unused rations may not be returned to any location south of the Tropic of Capricorn due to quarantine regulations. Finally, they noted that there are times when a soldier may open the outer pack but not use the items (for example when usage is anticipated, but then does not occur). When this does occur the whole pack has to be disposed of, even though the items have not been used.

Comment: Reducing wastage is a challenging issue. Better configurations for rations and improvements in the logistics system may ease this problem. Investigation should take place into the appropriateness of requiring CRP that have crossed the Tropic of Capricorn (from south to north) to be eaten or discarded, and not to be returned south of the Tropic of Capricorn.

When asked to nominate items that are regularly discarded, soldiers listed many items. The retort meals were often mentioned (including Beef Meatballs with Sweet and Sour Sauce; Beef Satay; Beef and Gravy, Dutch style; Salmon and Pasta Mornay; Vegetable Curry; BBQ Chicken). Other commonly discarded items were muesli bars, lollies, sauces, sugar, the ancillary pack, freeze dried rice, potato and onion powder, the new chocolate pebbles, marmalade, soup, dry biscuits, tea bags, coffee and ration chocolate. Reasons for not eating these items included perceptions of poor quality, unpalatability, a lack of time, a poor fit to the environment (e.g. dry biscuits in hot weather) and menu/flavour fatigue.

Comment: Regular monitoring (e.g. perhaps on a five-year rolling basis) of the acceptability and service suitability of CRP in the field is necessary.

Some of the non-food ancillary items were considered essential. These included the can opener/spoon (commonly known as 'FRED'—the Field Ration Eating Device), the plastic spoon, the toilet paper, the ziplock bag and the rubber band.

Comment: The non-food ancillary items were generally highly valued.

3.2.5 Perceived promoters of CRP design

Promoters of CRP design (factors that soldiers believe would support re-design of ration packs) were not mentioned. However, soldiers volunteered a number of ideas for CRP design to help promote consumption. A number of these ideas reinforced earlier comments.

Increasing variety was considered essential. Suggestions for achieving this included: having more menus; packing each box with a variety of menus; and cycling products and menus over a number years. Making small alterations to the menus each year (as now occurs) was considered to be insufficient to markedly reduce menu fatigue.

Updating products and including more commercially available products was also suggested. Commercial products were regarded as reliable, authentic and of superior quality to military-specific items. Replacing them with substitutes (no brand items) or repackaging items in 'army wrapping' was considered less desirable.

Convenience was continually stated to be an important factor. To soldiers this means products that are easy to prepare, carry and eat, and that use minimal packaging.

> **Comment:** CRP redesign should include introducing more variety, new items, ensuring all items are compact and convenient, and use the minimum packaging required to ensure product integrity and safety.

In addition, energy-dense foods (which enable the consumption of a considerable amount of energy in a few bites while on the move) such as sports bars were highly desired. It was suggested that these should be regularly provided as supplements—'by the box so you can grab a couple'—when issuing rations.

There is also a perceived need for some comfort foods, to enable soldiers to heat a meal or have a brew when conditions allow. The pattern of snacking during the day and eating something more substantial in the evening (when possible) was described as being desirable.

The addition of 'recovery'[2] foods was suggested. These were considered to be important immediately following arduous physical work, when it is difficult to eat a normal meal. Shakes were suggested for use in this situation.

> **Comment:** Ration pack design needs to consider the inclusion of energy-dense items, comfort foods and recovery foods; and to identify an appropriate balance between these types of foods.

The need for items to have drab olive-green packaging was questioned, and the practice of taking supplements (either provided to the soldier or personally obtained) was used to dispute the need for camouflage packaging.

> **Comment:** The need for camouflage packaging for CRP items has been questioned previously, and continues to be questioned.

Nutrition education was also considered important. Soldiers generally believed that there is a lack of understanding about what they should be eating. They considered that many soldiers choose inappropriate supplements or jack rations, and that there has been a lack of education in this area.

> **Comment:** Nutrition education should be implemented, including instruction on how to use ration packs, and what foods are appropriate in field and operational situations.

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[2] Recovery food should include nutrients that: replenish muscle and liver glycogen (carbohydrate) stores; replace fluids and electrolytes; repair and rebuild muscle protein; manufacture new red blood cells; and protect immune function.

3.2.6 Perceived barriers to CRP design

There were a number of perceived barriers to delivery of ration pack improvements.

It was believed that the current logistics system is unable to support the suggested options to increase variety. In the current climate of cost consciousness, e.g. the Strategic Reform Program (SRP), there was little faith that the cost of any improvements would be supported.

The range of climates, environments and situations presents an ongoing challenge for CRP design. A common perception was that it would be impossible to design CRP for the complete range of environments, roles, individual tastes and cultural preferences that exist.

Striking the balance between light-weight dehydrated products (that require the addition of water) and heavier items (that do not) was considered difficult. The move to drier environments has made this balance more precarious, as soldiers still desire light-weight foods but now face a higher water burden.

> **Comment:** Cost, logistics and the wide range of climates in which ADF operations occur, and the changing nature of those operations, all pose challenges for CRP design. These, along with other constraints, are considerable challenges in any design process and subsequent development of improvements to CRP.

3.2.7 Suggestions

Many suggestions were offered on how to improve CRP, i.e. to make them more appealing and more suited to the needs of users.

Firstly it was suggested that there should be more of a commitment to the policy to feed fresh wherever possible, rather than the inconsistent approach to rationing that appears to transpire.

General suggestions for CRP were to: increase variety; cycle menus; provide meals that do not require heating; improve the main meals (in terms of quality and provision of energy); include packages that can be resealed and provide more items for 'grazing'. Some soldiers would like to see the removal of the hexamine-based heating system (hexamine tablets and a folding aluminium stove) and its replacement with a better system, e.g. a flameless ration heater such as that used by the US Army.

Suggestions for alternative ration configurations included: modular systems (based on shelf life, climate, meal components or self-selected); an individual meal ration; a three-day pack; a tiered system (the bare essentials working through to meals); light-weight rations; a pack for use by troops in vehicles and another for dismounted troops; and a pack for short-term/high-intensity operations (perhaps similar to the US First Strike Ration).

There were many suggestions for new food items, which are listed below:

Lucozade sports drink powder	Protein shakes
Bread (i.e. long-life)	Improved muesli bars

Carbohydrate gel packs
Sports drink in sachets
Greenseas tuna packs (variety of flavours)
Fruit bars
Trail mix
Dried apricots
Dried apples
Protein bars
Ham in a retort/sachet
Fruit in a sachet
Different varieties of M&Ms
Tabasco sauce
Multivitamins
Protein powder
Tortilla wraps
Noodles
Nuts, including cashews
Salami sticks
Heinz or Campbells 'Hot pots'
Improved tea and coffee
The Natural Confectionery Co lollies (snakes, jubes)
'Sustenance' or energy bars (including bars that resemble a dense cake)
Smoked chicken breast
Cheese in a tube
Chicken in sachets (similar to the tuna)
Campbell's Chunky soup
Myoplex tetra packs
UHT milk drinks
Beef jerky
Stag canned meals
Pita bread
Powerade sports drink
Improved baked beans
Spaghetti
Power bars
Breakfast bars
High protein chocolate
Meal replacement shakes
Recovery foods
Skittles
Musashi bars
Coffee sachets (e.g. Lattes, Cappuccino)
Health bars (nutritional bars - with seeds, nuts and dried fruit)
Hoo-Ah bars (currently in some US combat rations)

Suggestions were also made for non-food items:

Hygiene wipes
Hand sanitiser (alcohol wash)
Ziplock outer bag
Two bags – one for rubbish and one for re-packing ration items that have been only partly consumed

Comment: Suggestions for improving ration packs reinforced the need for variety, convenience and quality items. Suggested alternative ration configurations included: modular systems; individual meal rations; three-day packs; tiered systems; light-weight rations; a pack for troops in vehicles and one for dismounted troops; and a pack for short-term/high-intensity operations. There were many suggestions for new food items based on current usage of military-supplied supplements and jack rations.

3.3 Concept Ration Design and Evaluation

After consideration of the stakeholder input, user input and DSTO corporate knowledge, six concept rations were developed for evaluation. The rationale for each concept, along with the results of evaluation is discussed below.

3.3.1 Part Day Ration (PDR)

Description and rationale

The PDR is designed for use when troops do not have access to other food for part of the day, e.g. if a patrol leaves base after breakfast and returns before dinner. It provides approximately one-third of the daily energy requirement of an active soldier, and fits in pockets or webbing. It could be used to replace a single meal, or provide snack items over a portion of the day. For nutritional criteria and a suggested menu see Appendix A. However, as a caveat it is noted here that the Individual Meal Combat Ration (IMCR), which was introduced into service in the 1980s for situations where some fresh feeding was available or when soldiers were moving for short periods, was not entirely successful, and was withdrawn from service in the 1990s.

Positive comments about the PDR concept

The soldiers collectively agreed that they liked the concept of a PDR. There was a general consensus that the PDR would be very useful for day patrols, which are common during training and on operations. The reasons they considered the PDR to be advantageous for a day patrol include the light-weight, compact, convenient and practical nature of the suggested pack. Troops would not have to carry an entire 24-hour ration pack, so load carriage would be reduced. Further, no time is wasted stripping the ration pack before a patrol. Instead, the PDR contains all the necessities and is ready to go.

The soldiers commented that the eat-on-the-move items would be useful for an energy boost when there is not enough time to stop and have a meal. It could also be utilised to sustain the individual until the next meal time when working out of a Forward Operating Base (FOB).

Soldiers generally believed that a higher proportion of the food items in the PDR would be consumed than in the CR1M, indicating a likely higher acceptability for the PDR. Most soldiers stated that the packaging, brands and flavours played an important role in increasing acceptability.

Participants thought the combination of items in the PDR was good, incorporating the major macronutrient energy sources. They considered the food items would retain their structure in the heat, increasing acceptability and palatability. They also recognised that sweat losses were considered in the PDR design, and the inclusion of items that assist with replacing essential electrolytes to maintain optimal performance was well received.

It was highlighted that the current CR1M could be improved if some of the items in the PDR were included in the CR1M. Further, the soldiers believed that the PDR would be suitable for a 24-hour mission if a main meal, packet of noodles and a brew kit were included.

Negative comments about the PDR concept

The main concern regarding the PDR concept was that it contained too many sugar-based snack products that do not adequately sustain soldiers. The soldiers felt that these foods would be quickly digested and the glucose they contain would be rapidly used or stored, leaving the individual feeling lethargic and flat, and so reducing overall performance.

> **Comment:** The scientific evidence for such an effect (known as 'rebound hypoglycaemia') is weak [11], but soldiers' perceptions should be taken into account, even if they are not scientifically sound (not least because of possible effects on morale).

The soldiers recognised the importance of high glycemic index (GI) foods for recovery, as these carbohydrates are more quickly digested and stored than low GI carbohydrates, preparing the soldier for the next period of high-intensity work. Yet the soldiers also requested that the PDR include a low GI carbohydrate-based meal, which is slowly digested and stored, for consumption during a rest period.

> **Comment:** There appeared to be a desire for both low and high GI foods in the PDR. A combination of different GI foods would allow soldiers to determine which foods are most appropriate for their current situation—static or high tempo. The sugar-based snack food items are intended to provide short bursts of 'instant energy' to fuel soldiers when they must move rapidly and quickly, and also to replenish carbohydrate reserves (in the form of liver and muscle glycogen) between bouts of vigorous physical activity. Fresh rationing would be employed to meet the soldiers' remaining energy requirements, at either end of the day. The requests for more meal-based items would push this concept closer to a 24-hour ration, which is not the purpose of this concept.

3.3.2 Light-Weight Ration (LWR)

Description and rationale

The LWR is designed for use by highly mobile units engaged in activities lasting up to three days. It provides around half of the daily energy requirement of an active soldier; the weight and bulk are less than half those of the current CR1M. After three days use, other rationing (either fresh or 24-hour CRP) would be required. For nutritional criteria and suggested menu see Appendix A.

This ration was based on a concept developed in 2005, with minimal product substitution. The decision was made to evaluate it with this group to provide feedback from current ADF members, and to allow comparison of the results with the other concepts.

Positive comments about the LWR concept

The LWR concept generally received positive feedback. The ration items were considered to be highly acceptable, and the majority of soldiers stated they would happily consume the LWR in the field. The soldiers commented that the majority of items in the LWR were

packaged in civilian wrapping, which may increase the likelihood of acceptability and therefore of consumption.

It was collectively agreed that the concept of a LWR could be utilised for a number of different scenarios, including: day patrols, infantry missions, long marches in patrol or marching order, working out of FOBs, short-term/high-intensity operations, and for section or platoon attacks when troops are in patrol order and so are unlikely to have adequate stowage space for 24-hour ration packs. They considered the LWR would be useful in these scenarios (which involve high levels of mobility) because it is compact, practical, convenient and light-weight.

The size and weight of the LWR received a positive response as it is similar to the total size and weight of components soldiers currently take into the field once they have broken up the CR1M and discarded unwanted items. The soldiers favoured the removal of canned products and superfluous items, and suggested food products should be packaged using cryovac technology to reduce load and to increase stowage space.

Negative comments about the LWR concept

The primary issue raised in regard to the LWR concept was the inadequate amount of food items to sustain highly mobile units for activities lasting up to three days. The soldiers were concerned that the quantity of food in the LWR would not sustain troops during a prolonged high-intensity exercise, especially when they are wearing combat body armour. Some individuals thought the LWR would be better suited as an emergency ration, an overnight ration or for a light meal. Further, many soldiers stated that it is important for morale to be able to sit down at the end of the day and prepare a substantial meal that satisfies hunger, and they believe that the LWR does not allow this. It was suggested that additional main meals should be included in the LWR to maintain and enhance endurance, stamina and morale.

Soldiers commented that although most would consume all the food items in the LWR, some of the sugar-based snack food items are considered 'cheap fuel' and would not adequately sustain them. The soldiers recognised the importance of including high GI foods for recovery to replete glycogen stores, yet they requested that low GI foods are also included. This will allow the soldiers to utilise the appropriate GI food according to the situation they are involved in at that time-static or high tempo.

> **Comment:** The soldiers may have misunderstood that the LWR was designed to provide only half their daily energy requirement, and to be used for a specific mission over a maximum three-day period. The comments about the LWR not providing adequate quantities of food to sustain soldiers in the medium-to-long term (i.e. beyond three days) is not relevant, as other rationing would be utilised for recovery after a three-day period involving high levels of physical activity.

3.3.3 Whole Day – Meal Based Ration (WD-MB)

Description and rationale

Similar to the current CR1M, the WD-MB includes meals and snacks. It provides the average daily energy requirement of an active soldier. This concept represented what DSTO envisaged

an 'updated CR1M' may be like; that is retaining the structure of the current CR1M, but using food items identified as promising during previous research. For nutritional criteria and menu suggestions see Appendix A.

Positive comments about the WD-MB concept

The response in relation to the WD-MD ration was very positive. The soldiers reiterated throughout the focus group that they were extremely impressed with the overall concept, and they believe there is a need for this type of ration pack in the field. They agreed that the food items in the WD-MB concept were a vast improvement on the current CR1M, suggesting that the new pack would probably have a high acceptability rating. The combination of items in the WD-MB received positive feedback as there are appropriate foods for each main meal of the day, with sufficient snack items for consumption between main meals. The soldiers commented that the food items in the WD-MB are suitable for the missions they are involved in, and meet their perceived requirements for a 24-hour period.

The soldiers thought the addition of a camouflaged resealable ziplock outer package was an excellent idea and would be of great value in the field. Currently, soldiers open their CRP, discard unwanted items, and replace wanted items in the outer package. A rubber band is then used to secure the outer package, but this is not practical as the band does not always secure the outer package properly, so some ration items tend to fall out. Implementing a ziplock resealable bag would overcome this problem. The ziplock also means the soldiers can carry their waste packaging (and other waste items) in the resealable bag, reducing the likelihood that waste items will accidentally be released into the environment. It was suggested that adding a ziplock to the bag containing the ration would be a simple and valuable improvement that could easily be made to CRP in the near future.

> **Comment:** Soldiers may have been receptive to the WD-MB ration as it is a similar concept to the current CR1M, which they are accustomed to. It was immediately obvious to them how this pack would be used and adapted to the duties they perform in the field. They also responded positively to the items that were used in the concept.

Negative comments about the WD-MB concept

There was minimal negative feedback about the WD-MB concept. The main issue raised was that there were too many chocolate-flavoured products in the WD-MB ration. The soldiers would prefer a larger range of flavours to prevent flavour/menu fatigue. They also proposed many alternative or more popular food items that could be included or substituted in the WD-MB concept. These items are shown in Section 3.2.7 of this report.

3.3.4 Whole Day – Snack Based Ration, Hand to Mouth (WD-SB-H2M)

Description and rationale

The WD-SB-H2M comprises eat-on-the-go snack items which can be eaten directly from the packaging with no preparation. It provides the daily energy requirement of an active soldier,

and is similar in weight and size to the current CR1M. For nutritional criteria and menu suggestions see Appendix A.

Positive comments about the WD-SB-H2M concept

A few soldiers commented that the WD-SB-H2M concept would be useful for a high-tempo operation when there is insufficient time or the operational situation does not allow soldiers to prepare a normal meal. Some also commented that the food items in this concept are ideal for short-term/high-intensity operations.

However, the general opinion was that the concept needs further development. Soldiers acknowledged that the WD-SB-H2M concept was suited for certain situations and commented that this concept has some merit if it were to be used to sustain troops engaged in tasks of short duration.

Negative comments about the WD-SB-H2M concept

The majority of the remarks about the WD-SB-H2M concept were negative. The major perceived problem was that it contains too many sugar-based snack items that have little or no nutritional value to adequately sustain troops. The soldiers collectively agreed that the WD-SB-H2M concept would be suitable for short-term operations (maximum 48 hours) but not for sustained high-intensity operations.

The soldiers agreed that sugar-based items are suitable for those involved in high tempo missions, expending large amounts of energy and who need an immediate source of fuel. However, they considered the percentage of soldiers who fall in this category to be minimal, and these products will not benefit those remaining soldiers in a static situation.

It was suggested that this type of ration would be useful as a supplement in addition to the normal ration, to be used 'as required' across sustained operations rather than being consumed as a 24-hour ration. The soldiers believed that the H2M could be useful if it was supplemented every 24 hours with fresh rations. This is different to the US First Strike Ration which provides high energy snacks for up to 72 hours, after which soldiers are fed with combat rations (such as MREs) or fresh rations.

Overall, the general consensus was that the rationale behind the concept is good, but there needs to be a balance between ready-to-eat foods, slow-energy-release foods and at least one main meal to feel satiated, refuelled and prepared for the next mission.

> **Comment:** The inclusion of high-energy, sugar-based snack items in the WD-SB-H2M concept is justified. The design allows eating while on-the-move, directly from the packaging, to provide an instant source of energy to refuel and maintain a soldier's performance when involved in high-intensity operations with minimal rest periods. The WD-SB-H2M concept would only be utilised in these types of scenarios for a short duration, and fresh rations would be employed where practicable. This concept was not designed to be a supplement; rather it is intended to be a 24-h ration. It appears that this concept has fallen short of what soldiers expect a convenient on-the-move ration to be.

3.3.5 Whole Day – Snack Based Ration, Minimal Preparation (WD-SB-MP)

Description and rationale

The WD-SB-MP comprises snack items requiring minimal or no preparation. It satisfies the average daily energy requirement of an active soldier, and is similar in weight and size to the current CR1M. For nutritional criteria and suggested menus see Appendix A.

Positive comments about the WD-SB-MP concept

Comments on the WD-SB-MP concept were generally positive. In particular, soldiers remarked on the variety of new and different food items present in the WD-SB-MP, while recognising that it still retained some of the favourite items of the current CR1M. The soldiers believed that the food items would be enjoyed by virtually every user, and that the components would be shared and exchanged between soldiers, thereby indicating that this concept ration is likely to have high acceptability.

The soldiers commented that the SB-MP concept was suitable for situations when the workload is demanding and there is not sufficient time to prepare a meal. Therefore, the WD-SB-MP concept would be appropriate for a short duration patrol (up to 24 hours) because the food items are snack-based, requiring minimal or no preparation, and can be stowed in easily accessible places, such as pockets or webbing, to allow them to be eaten while on the move.

> **Comment:** These comments are in accordance with the rationale of the WD-SB-MP ration and indicate the soldiers' understanding of the concept. The perceived advantages of this type of ration for specific circumstances are in line with the concept design.

Negative comments about the WD-SB-MP concept

The primary concern raised with the WD-SB-MP ration was the lack of a main meal. The soldiers commented that the ration consisted predominantly of snack-based items, and it would be preferable to include a main meal if troops were on a fairly static exercise where there was time to prepare a meal.

> **Comment:** The soldiers' concerns about the concept may not be relevant as the WD-SB-MP ration would not be employed in a static scenario; a more appropriate ration that is suited to that situation would be selected.

3.3.6 Modular Energy System Ration (MES)

Description and rationale

The MES consists of base modules with smaller 'add-on' (or supplementary) modules. A base module would provide enough energy for a soldier conducting static duties; the base module plus one supplementary module would provide the daily energy requirement of an active soldier. This concept represents a 'tiered system' based on the nature of the duties being

conducted. Many other modular configurations are possible, and would need to be considered in future work. For nutritional criteria and suggested menus see Appendix A.

Positive comments about the MES concept

The remarks about the MES concept were very positive. The soldiers collectively agreed that the MES concept was an immense improvement on the CR1M, which is currently broken down to remove items soldiers do not want. The general opinion was that there would be no need to break down the MES ration as the food items in the base and supplementary modules are of high acceptability, and include food items that are already taken into the field as jack rations.

The soldiers commented that the combination of food items in the MES concept was ideal as they are in line with the type of products the soldiers believe they need for optimal performance—low GI foods with a slow release of energy to adequately sustain them during missions, versus high GI foods which provide an instant release of energy that (they believe) does not sustain them.

It was agreed that the concept of a base module with smaller supplementary modules was advantageous as it offers the flexibility to be adaptable to different scenarios, depending on the level of energy expenditure and length of the operation or field exercise. For example, when soldiers are on a static exercise, or engaging in light duties with minimal energy expenditure, they may require only the base module. If the soldiers' energy expenditure increases, supplementary modules may be utilised as required. The current CR1M does not offer this flexibility and adaptability. Further, the soldiers commented that the MES ration was much lighter than the CR1M. This is a major advantage as it reduces the soldiers' load carriage.

Another perceived advantage of the MES concept is the provision of a variety of base and supplementary modules to choose from. Introducing a variety of food options will assist with preventing monotony and menu fatigue, and will allow soldiers to choose the base and (if appropriate) supplementary modules they prefer.

The soldiers stated that the brands and coloured packaging in the MES concept would improve acceptability of these foods and enhance morale. It was reiterated that the lack of camouflage packaging would not be an issue in the field, as the waste would be collected in the camouflage resealable bag. The resealable bag received a positive response as the CR1M produces a lot of waste that must be carried.

The general consensus in the focus group was that the MES ration was an excellent concept, and with a few minor adjustments it would be suitable in the field.

> **Comment:** The concept of a base module with smaller supplementary modules to meet individual soldiers' energy requirements, nutritional requirements and food preferences is a modern and flexible approach to ration design. The soldiers' comments indicate their understanding of the advantages associated with employing MES in the field. It also fits with the existing understanding of

'regular' and 'arduous' duties, and therefore should be relatively easy to put into effect.

Negative comments about the MES concept

Participants commented that there are two main meals plus rice and noodles in the CR1M for a 24-hour period, and these are usually eaten at lunch and dinner. The MES concept ration has only one main meal in the base module with either rice or noodles. The general opinion was that this is insufficient for their energy requirements and they would prefer two main meals in the base module, with snack items in the supplementary modules.

There was a widespread belief that most individuals would probably eat the base module plus the first supplementary module even if energy expenditure is relatively low. It was suggested that the first supplementary module should be incorporated in the base module.

Comment: The MES concept may appear to be restricted in comparison to the CR1M, yet the modular system allows the provided rations to be tailored to the soldiers' energy requirements. Therefore, it is more flexible and less restricted than the CR1M.

3.4 Item Evaluation

Soldiers examined, discussed and evaluated individual food items in each concept. The comments were categorised as *positive* or *negative*. Soldiers also suggested possible solutions to overcome the negative aspects associated with food items. In some instances no comments were made about the item. Note that the participants' perceptions and opinions of some items may not be technically correct. For example, they commented that several of the products have little or no nutritional value; this belief is not correct, but it provides an insight into the soldiers' opinion of the food which influences acceptance and consumption. Therefore, these comments have been included in the item evaluations, which are shown in Appendix B.

At times discussions strayed from the food items contained in the concept rations to aspects of food items currently in the CR1M (but not used in the concept rations). Soldiers also suggested possible solutions to overcome negative aspects of the CR1M. These comments were categorised as *positive* or *negative*, and are shown in Appendix C.

Although not necessarily linked to the concepts being presented, soldiers raised general concerns and issues about the existing CR1M. These comments were classified as *negative*. Soldiers suggested possible solutions to overcome these negative aspects. Comments are shown in Appendix D.

4. Discussion

Stakeholders identified a number of deficiencies with the current CRP, including a perceived need for solutions to the problems of part-day rationing, feeding cadets, and feeding civilians during humanitarian operations. Major challenges were considered to be load carriage, changes in military roles and changes in equipment. It was generally believed that providing nutrition education, and increasing acceptability, variety and satiety are essential steps in any program aimed at overcoming under-consumption of CRP and ensuring that CRP meet both the needs *and* wants of ADF members.

From the user input a need was identified for flexible options or alternative configurations that cater to a variety of situations. Variety, convenience and minimal preparation were identified as the key features required in CRP items. Investigation of commercial sports products, the inclusion of energy-dense products and the provision of more education in the use of CRP were also considered to be essential elements of a strategy that will encourage consumption. A number of current products were considered unsatisfactory, most notably the retort meals, and a number of new products were suggested for inclusion.

Of the six concept rations that were developed and evaluated, four show promise for further development and evaluation. The Part Day Ration (PDR) and Light-Weight Ration (LWR) both represent light-weight solutions for highly-mobile units. The PDR was designed to be used to replace a single meal, while the LWR was designed as a 72-hour ration (after which other rationing would be employed). They offer the advantages of reduced load carriage and less waste, while providing convenient eat-on-the-go foods. They (intentionally) do not provide the average daily energy requirement for active soldiers, but there will be a subsequent period of recovery rationing, during which energy reserves will be restored. Introduction into service of either the PDR or the LWR would require guidance and education on how and when they should be issued, and how they should be used by soldiers.

The Whole Day – Meal Based Ration (WD-MB) also shows promise for further development. This concept represents what an 'updated CR1M' might look like. It has the advantage of increasing user acceptability without the burden of great changes in the way rations are issued or the way soldiers are using them. However, the WD-MB does not offer any benefits in terms of load carriage, flexible rationing configurations or adaptability to specific roles. This could be viewed as a partial or intermediary step to improving rations.

Modular systems hold potential for improving the efficiency and effectiveness of rationing with CRP. The Modular Energy System ration (MES) examined here was well received and could be further developed. Most soldiers are accustomed to having a 'regular' or 'arduous' entitlement to rations. Therefore, a system such as the MES might fit with a static/active/arduous rationing plan. Other modular configurations could be developed based on climate, component type or shelf life.

These data also provide an insight into the perceived problems with current CRP, and suggestions for improvements. Retort meals continue to cause complaint, and this long-standing issue needs attention. Some snacks are considered to be in need of replacement, and the quality of other ancillary items could be improved. Soldiers have provided many

suggestions for inclusion of commercial items, particularly those from the range of available sports supplements.

Three options are presented here for consideration. The first is to pursue an improved CR1M using the soldier feedback reported here and feedback reported elsewhere [12-16]. This option will deliver a partial solution, improving the current model and placing no burden on users to adapt to new styles of rations, or on the current logistics system. However, this option does not enhance flexibility or adaptability to specific situations.

The second option is to further develop light-weight rations such as the PDR and LWR described in this report. This would expand the current ration suite, addressing the need for light-weight rations for highly mobile units. Introduction of these types of rations poses challenges to logistics, and requires guidance as to when and how they should be used by soldiers.

The third option is to pursue modular rations. This option offers the most flexibility, giving the potential for rations to be tailored to a wide variety of situations. It may also offer a way to shorten the required shelf life of some modules/items, allowing a number of less stable but highly acceptable food types to be introduced. Modular rations would represent the most complete solution, but this concept also carries the highest development, logistics and change management burden.

These three options could be pursued in series—progressing from improvements to the existing CR1M, to the introduction of light-weight options (which may become modules), then finally to modular rations.

In this study a number of concept rations were developed and evaluated. Each had a sound nutritional profile suited to the purpose of that concept, and was designed to address known issues and incorporate user suggestions. The concept rations were tested with users to determine whether they were worthy of further development. There are a number of other issues that will need to be considered in the further development of concept rations, including cost and whether the logistics system can support the suite of new rations. These challenges, along with other constraints, will have to be carefully considered during the design process and in development of the case for the introduction of improvements to CRP.

The purpose of this work was to develop concept rations that address current CRP issues and anticipated areas of lack of fit/suitability. To achieve this, a consumer-focussed data collection methodology was adopted to develop concept rations for initial evaluation. The strengths of this method include an understanding of the reasons why consumers do or do not consume CRP foods, and the development of solutions grounded in the knowledge of the actual users, rather than the minds of the developers. However, the findings from this work should be considered to be pilot work, and the concepts will require further development and testing.

5. Conclusions

The first part of this work contributes a strong user perspective of current CRP and the weaknesses and strengths of these packs. Conclusions on how improvements to CRP feeding may be brought about effectively and efficiently are:

1. CRP design will need to cater for a range of demands. Tailoring CRP to every situation is not expected to be a viable solution. Flexible options that cater to a variety of situations would provide much more practical solutions.

2. Fresh feeding—or at least having ration pack feeding broken up with the occasional fresh meal—should be made available as soon as possible in a field situation. Current efforts in this area need to be sustained and supported, to enhance soldier morale and ensure optimal health.

3. Alternative configurations may reduce the need to strip rations as aggressively as now occurs. Configurations may include: modular systems (based on shelf life, climate, meal components, or self-selection); part-day or single-meal rations; a three-day pack; a tiered system; light-weight rations; a ration for troops in vehicles and one for dismounted troops; and a pack for short-term/high-intensity operations.

4. CRP design needs to maximise variety within and across menus, and at the point of issue. This may be achieved by: packing a variety of menus in each ultimate container; cycling items through menus over a number of years; and continually adding new items.

5. CRP items need to be compact, convenient and easy to use, as these are the main features that soldiers look for. It is important to include items that can be eaten with no preparation.

6. Ration pack design needs to consider the inclusion of energy-dense foods, comfort foods and recovery foods, and to identify an appropriate balance between these types of foods.

7. Retort meals continue to be a cause for complaint, and the problem with the quality of the meat in retort meals needs to be addressed.

8. Freeze-dried meals should be considered for use in a number of ration configurations as they are well liked. This needs to be balanced with the added burden of water availability. Consideration may be given to configurations that contain both dehydrated meals and retort meals.

9. Commercial sports products should be investigated for possible inclusion in CRP. Easy-to-prepare shakes may also be a worthwhile addition. Food items that are currently taken as military-supplied supplements or jack rations might also be considered for inclusion.

10. The need for CRP items to be camouflaged is questionable. Users did not consider camouflage packaging to be essential for all items, or in all situations, and emphasised the benefit of including branded products as the familiarity is comforting and they impart a higher impression of quality.

11. Nutrition education should include instruction on how to use ration packs and what foods are appropriate in field and operational situations.

12. Cost, logistics, and design for a number of climates and roles all pose challenges for CRP design, and will have to be carefully considered during concept development.

After consideration of the stakeholder input, user input and DSTO corporate knowledge, six ration concepts were developed and evaluated in a field setting. The conclusions as a result of this evaluation are:

1. Part Day Ration (PDR).
   ⇒ Concept well received and worthy of further development.

2. Light Weight Ration (LWR).
   ⇒ Concept well received and worthy of further development.

3. Whole Day – Meal Based Ration (WD-MB).
   ⇒ Concept well received and worthy of further development.

4. Whole Day – Snack Based Ration, (WD-SB-H2M).
   ⇒ Concept not well received, not worthy of further development unless major modifications are made.

5. Whole Day – Snack Based Ration, Minimal Preparation (WD-SB-MP).
   ⇒ Concept not well received, not worthy of further development unless major modifications are made.

6. Modular Energy System Ration (MES).
   ⇒ Concept well received and worthy of further development.

As a result of this evaluation there appears to be three main courses of action that should be considered. These options are summarised below in order of increasing complexity as well as increasing level of solution delivery, and could be pursued in serial order:

1. Improve the existing CR1M by further investigating the issues and suggestions highlighted in this study and supported by other DSTO reports.

2. Further develop light-weight rations for highly mobile units.

3. Develop a modular rationing system.

A further option may be to combine the three courses of action into a modular system (for example where light-weight options may be used as stand-alone rations or as modules that

can be used to build a variety of rations). The challenges of cost, logistics burden, change management and other constraints will have to be carefully considered during design and in development of the case for further improvements to CRP.

6. Recommendations

It is recommended that:

1. The merits of each of three courses of action be considered in light of current knowledge of military nutritional requirements, food science, cost, logistics, change management and other constraints.

2. A case be developed for each of these options to be pursued in series—progressing from improvements to the existing CR1M, to the introduction of light-weight options (which may become modules), then finally to modular rations.

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8. References

1. Booth, C. K., et al. (2003) The physiological and psychological effects of combat ration feeding during a 12-day training exercise in the tropics. *Military Medicine* **168** (1) 63-70.
2. Carins, J. E. (2002) *The Acceptability of the Combat Ration One Man (CR1M) Ration Pack in the Field: A Survey*. DSTO Scottsdale Internal Report, Scottsdale, Tasmania, Defence Science and Technology Organisation.
3. Forbes-Ewan, C. H. (2001) *Acceptability and Service Suitability of the Combat Ration One Man during Operation Warden*. Defence Nutrition Research Centre Internal Report, Scottsdale, Tasmania, Defence Science and Technology Organisation.

4. Forbes-Ewan, C. H., et al. (1988) *Food Intake and Energy Expenditure of Soldiers Undergoing Jungle Warfare Training*. MRL-R-1130, Tasmania, Materials Research Laboratory, Defence Science and Technology Organisation.
5. IOM (Institute of Medicine U.S.). Committee on Military Nutrition Research (1995) *Not eating enough: overcoming underconsumption of military operational rations* Marriott, B. M. ed. Washington, D.C., National Academy Press.
6. Krueger, R. A. and Casey, M. A. (2000) *Focus Groups. A Practical Guide for Applied Research*. 3rd ed. Thousand Oaks, California, Sage Publications.
7. Department of Defence (2009a) *Integrated Logistic Support Instruction In-Service Management (Version 3). Army Logistic Instruction MM 1-65 Combat Rations.* ALI MM 1-65, Issue No. 1.0. Land Systems Division, DMO, Commonwealth of Australia.
8. Department of Defence (2009b) *User Requirements for Combat Ration Packs*. Issue 1.0 Dated October 2009, Authorised by P. Harris.
9. Forbes-Ewan, C. H. (2009) *Australian Defence Force Nutritional Requirements in the 21st Century: (Version 1)*. DSTO-GD-0578, Melbourne, Defence Science and Technology Organisation.
10. Department of Defence (2003) *Australian Defence Force Ration Scales and Scales of Issue (SUPMAN 4), Edition 6*. Army Material Management Agency Support Command Australia (Army), Editor. Directorate of Publishing, Defence Centre, Canberra.
11. Burke, L. M. (1998) Pre-Event Meals: High or Low Glycemic Index Foods. *Sportscience* (May-Jun) Accessible through: http://sportsci.org/.
12. De Diana, J. and McLaughlin, T. (in preparation) *Warranty Verification of Current Combat Ration Pack Components: 12 Months Progress Report on 09/10 Submission*. Melbourne, Defence Science and Technology Organisation.
13. McLaughlin, T. and De Diana, J. (2011) *Warranty Verification of Current Combat Ration Pack Components: 12 Months Progress Report on 08/09 Submission*. Melbourne, Defence Science and Technology Organisation.
14. Carins, J. E. and Tennant, M. L. (2011) *Influences on the Consumption of Australian Ration Packs: Review of a Contextual Model and Application to Australian Defence Force Data*. DSTO-TR-2526, Melbourne, Defence Science and Technology Organisation.
15. Carins, J. E. and Kullen, C. J. (2011) *Field Acceptability and Consumption of CR1M and Potential New Food Items during the Hot Weather Ration Trial*. DSTO-TN-1041, Melbourne, Defence Science and Technology Organisation.
16. McLaughlin, T., De Diana, J. and Coad, R. (in preparation) *Quality Assurance of Current Combat Ration Pack Components: 08/09 Submission* Technical Report, Melbourne, Defence Science and Technology Organisation.

Appendix A: Future CRP Concepts Booklet

UNCLASSIFIED

Australian Government
Department of Defence
Defence Science and
Technology Organisation

DSTO Future CRP Concepts 2010

In support of one of the objectives identified in STSR ARM10/0006 - Enhancing Nutrition for the ADF, DSTO recently conducted a trial to evaluate new concepts for Combat Ration Packs (CRP) during EX Hamel.

The concepts were based on information obtained from soldiers concerning usability, function, taste and food preferences. Both existing ration pack items and commercial-off-the-shelf food items were used to build the concept packs.

It is important to note that the brands and flavours used were only a sample of the available brands and flavours, and are used as ***examples*** in a ***concept*** ration.

Systematic analysis of the feedback from the evaluation sessions has commenced, and will be reported by June 2011.

The six concepts are listed below; more detail is given in the following pages.

a. Part Day Ration (PDR): For use when away from other feeding systems for part of the day. Provides around one third of the daily energy requirement of an active soldier, and fits in pockets or webbing.

b. Light Weight Ration (LWR): For use by highly mobile units, for activities lasting up to three days. Provides around half of the daily energy requirement of an active soldier; the weight and bulk is less than half of the current pack.

c. Whole Day – Meal Based Ration (WD-MB): Similar to the current ration pack, includes meals and snacks. Provides approximately the full daily energy requirement of an active soldier.

d. Whole Day – Snack Based Ration, Hand to Mouth (WD-SB-H2M): Comprising eat-on-the-go snack items, which can be eaten directly from the packaging. Provides approximately the full daily energy requirement of an active soldier, similar in weight and size to the current pack.

e. Whole Day – Snack Based Ration, Minimal Preparation (WD-SB-MP): Comprising snacks items, requiring minimal or no preparation. Provides approximately the full daily energy requirement of an active soldier, similar in weight and size to the current pack.

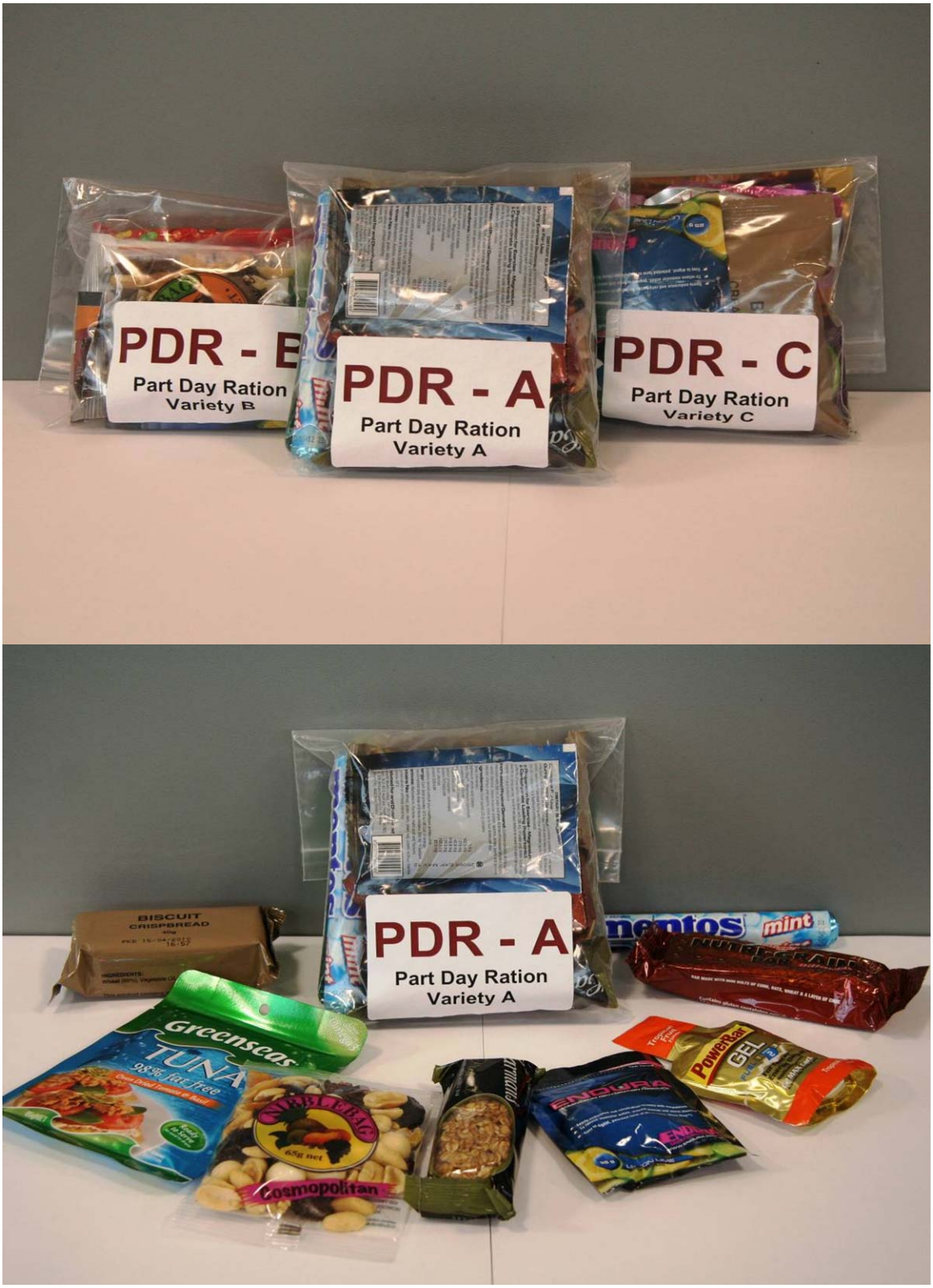
f. Modular Energy System Ration (MES): Consists of base modules with smaller 'add-on' modules. A base module would provide enough energy for a soldier conducting static duties, base module plus one 'add-on' provides approximately the daily energy requirement of an active soldier.

DSTO-Scottsdale CONCEPT RATION

Part Day Ration

	Recommended Nutritional Criterion for CRP		*Combat Ration One Man (CR1M)*		*Part Day (One Meal) Ration*			
			Current		Goal		Concept	
Size (cm^3)	-		3570		1000		980	
Weight (g)	-		1750		500		393	
Energy (kJ)	16,000		15,900		5,000		5143	
	g	% Energy Content	g	% Energy Content	g	% Energy Content	g	% Energy Content
Carbohydrate (g)	565-590	60-63%	624	65%	175	60%	189	62%
Protein (g)	122-150	13-16%	97	11%	45	15%	41	14%
Fat (g)	108-143	26-34%	116	25%	33	25%	33	24%

Legend:	
Meets goal (within 5%)	*green*
Positive departure from goal (more than 5%)	*light green*
Negative departure from goal (more than 5%)	*orange*


PDR - B
Part Day Ration
Variety B
PDR - A
Part Day Ration
Variety A
PDR - C
Part Day Ration
Variety C
PDR - A
Part Day Ration
Variety A
BISCUIT
CRISPBREAD
mentos
mint
Greensea
TUNA
98% fat free
Cosmopolitan
ENDURA
PowerBar
GEL

DSTO-Scottsdale CONCEPT RATION

Part Day Ration

CONTENTS SHEET

Variety A	Serve Size		Variety B	Serve Size		Variety C	Serve Size	
Tuna pouched, tomato	1 x	85	Jerky Steak bar, BBQ	1 x	25	Cheddar Cheese (Canned)	1 x	56
Crispbread	1 x	40	Scotch Finger	1 x	35	Cream Cracker	1 x	35
Nutri-grain Bar	1 x	30	Growling Dog Choc Bar	1 x	65	Growling Dog Berry Bar	1 x	65
Fruit & Nut Mix	1 x	65	Fruit & Nut Mix	1 x	65	GU Energy Gel Tri-Berry	1 x	32
PowerBar Tropical Fruit Gel	1 x	41	Shots Cola Vanilla Gel	1 x	45	Carmans Apricot Muesli Bar	1 x	45
Carmans Original Muesli Bar	1 x	45	Yoghurt Top Muesli Bar Strawberry	1 x	31	Fruitip Pastilles	1 x	34
Mentos Mint Flavour	1 x	38	Skittles Fruits	1 x	55	Jerky Pieces	1 x	25
Endura Lemon Lime Drink	1 x	25	Endura Lemon Lime Drink	1 x	25	Endura Lemon Lime Drink	1 x	25

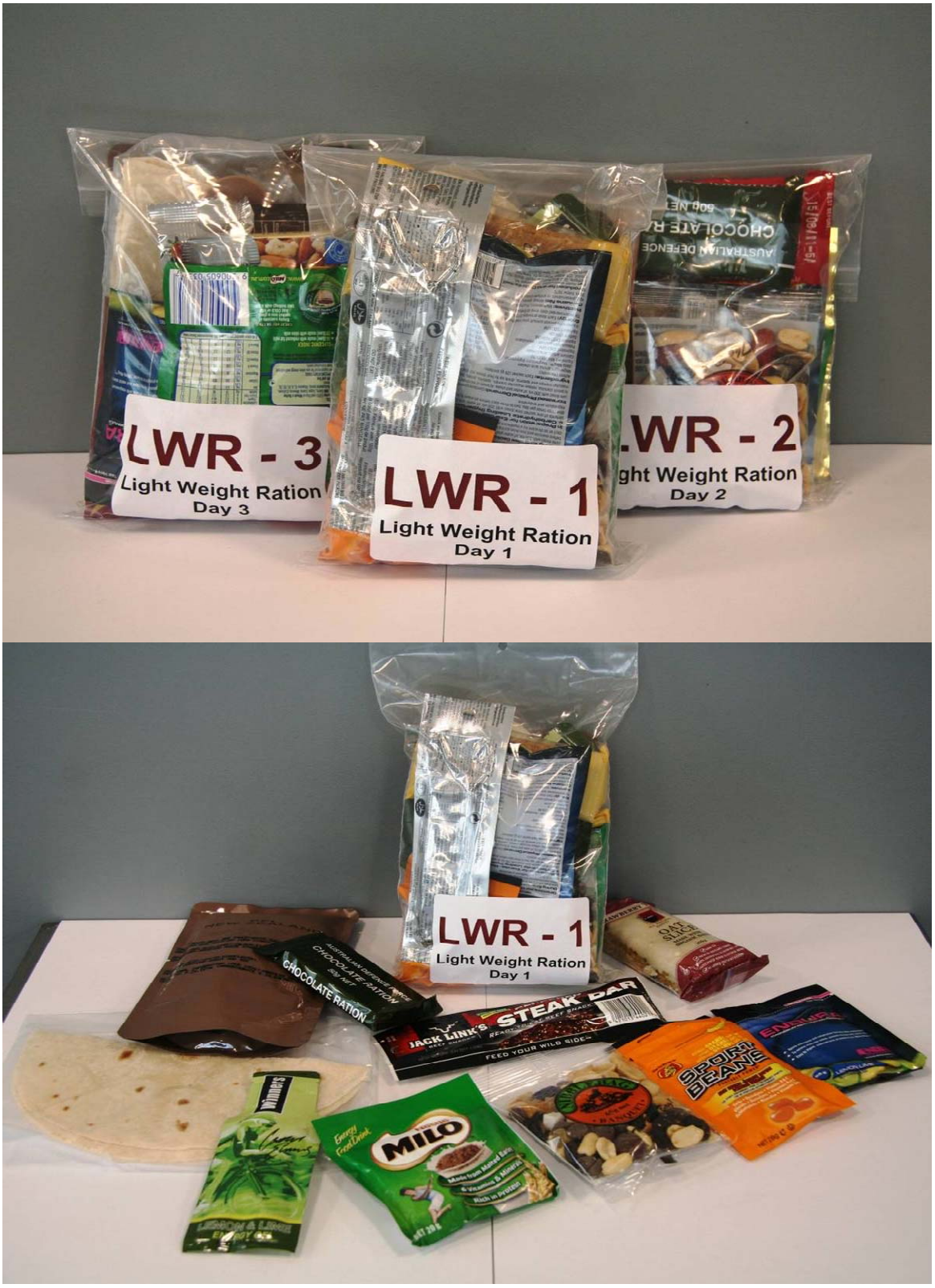
You can provide feedback on this concept to:
ration.packs@dsto.defence.gov.au

DSTO-Scottsdale CONCEPT RATION

Light Weight Ration

	Recommended Nutritional Criterion for CRP		*Combat Ration One Man (CR1M)*		*Light Weight Ration (LWR)*			
			Current		Goal		Concept	
Size (cm^3)	-		3570		2000		1960	
Weight (g)	-		1750		600		657	
Energy (kJ)	16,000		15,900		7,500		6,977	
	g	% Energy Content	g	% Energy Content	g	% Energy Content	g	% Energy Content
Carbohydrate (g)	565-590	60-63%	624	65%	275	62%	250	61%
Protein (g)	122-150	13-16%	97	11%	58	13%	59	15%
Fat (g)	108-143	26-34%	116	25%	50	25%	48	26%

Legend:	
Meets goal (within 5%)	*green*
Positive departure from goal (more than 5%)	*light green*
Negative departure from goal (more than 5%)	*orange*


LWR - 3
Light Weight Ration
Day 3
LWR - 1
Light Weight Ration
Day 1
LWR - 2
ght Weight Ration
Day 2
LWR - 1
Light Weight Ration
Day 1
CHOCOLATE RATION
JACK LINK'S
STEAK BAR
FEED YOUR WILD SIDES
MILO
Energy Food Drink

DSTO-Scottsdale CONCEPT RATION

Light Weight Ration

CONTENTS SHEET

Variety A (Day 1)	Serve Size	Variety B (Day 2)	Serve Size	Variety C (Day 3)	Serve Size
Oat Slice, Strawberry Yoghurt	1 x 100	Torq Bar, Raspberry and apple	1 x 65	Euphoria nutritional food bar, strawberry	1 x 60
Endura Lemon Lime Drink	1 x 25	Endura Lemon Lime Drink	1 x 25	Endura Lemon Lime Drink	1 x 25
Sport Beans, Orange	1 x 28	Skittles	1 x 55	Sport Beans, Fruit Punch	1 x 28
Fruit & Nut Mix	1 x 65	Fruit & Nut Mix	1 x 65	Sultanas	1 x 40
Steak Bar, Peppered	1 x 25	Beef Jerky, Original	1 x 25	Almonds & Yoghurt Sultanas	1 x 30
Ration Chocolate	1 x 50	Ration Chocolate	1 x 50	Growling Dog, Chocolate Bar	1 x 65
Winners Energy Gel Lemon and Lime	1 x 40	Endura Sports Gel, Citrus	1 x 35	Endura Sports Gel, Vanilla	1 x 35
Retort Meal, BBQ Beef	1 x 250	Tuna in Springwater	1 x 85	Retort Meal, Beef Minced with Spaghetti	1 x 250
Tortilla Bread	1 x 48	Biscuits, Crispbread	1 x 40	Tortilla Bread	1 x 48
Milo Drink Powder	1 x 20	Sauce, Sweet Chilli	1 x 10	Milo Drink Powder	1 x 20
		Milo Drink Powder	1 x 20		
Ancillary Pack		**Ancillary Pack**		**Ancillary Pack**	
Beverage, coffee, instant	2 x 3.5	Beverage, coffee, instant	2 x 3.5	Beverage, coffee, instant	2 x 3.5
Beverage, tea bags	2 x 2.5	Beverage, tea bags	2 x 2.5	Beverage, tea bags	2 x 2.5
Sugar	4 x 7	Sugar	4 x 7	Sugar	4 x 7
Dried Skim Milk	2 x 3	Dried Skim Milk	2 x 3	Dried Skim Milk	2 x 3

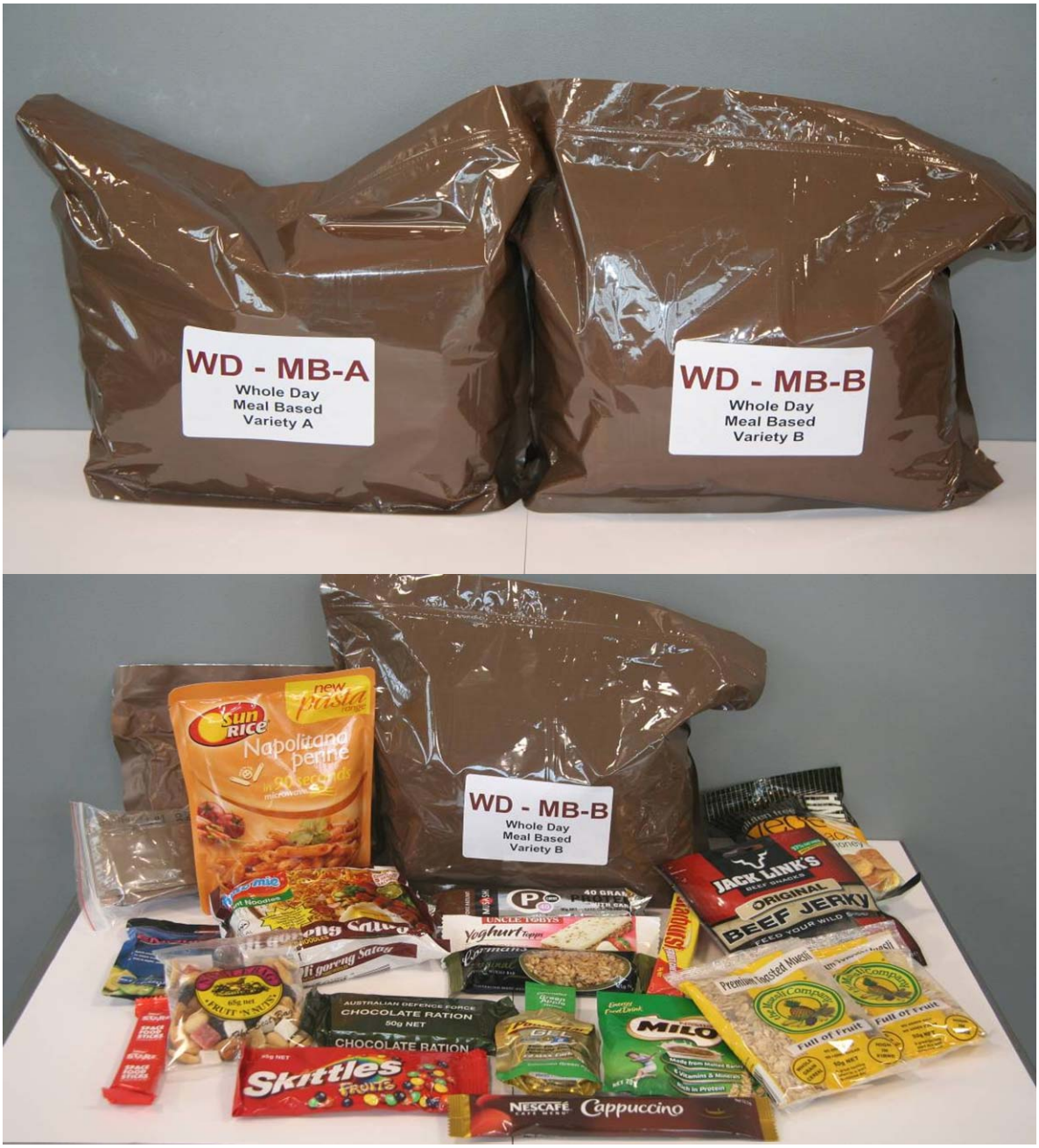
You can provide feedback on this concept to:
ration.packs@dsto.defence.gov.au

DSTO-Scottsdale CONCEPT RATION

Whole Day Ration - Meal Based

	Recommended Nutritional Criterion for CRP		*Combat Ration One Man (CR1M)*		*Whole Day Ration - Meal Based (WD- MB)*			
			Current		Goal		Concept	
Size (cm^3)	-		3570		3570		3600	
Weight (g)	-		1750		1750		1343	
Energy (kJ)	16,000		15,900		16,000		15817	
	g	% Energy Content	g	% Energy Content	g	% Energy Content	g	% Energy Content
Carbohydrate (g)	565-590	60-63%	624	65%	565	60%	507	55%
Protein (g)	122-150	13-16%	97	11%	140	15%	167	18%
Fat (g)	108-143	26-34%	116	25%	105	25%	119	29%

Legend:	
Meets goal (within 5%)	*green*
Positive departure from goal (more than 5%)	*light green*
Negative departure from goal (more than 5%)	*orange*


WD - MB-A
Whole Day
Meal Based
Variety A
WD - MB-B
Whole Day
Meal Based
Variety B
WD - MB-B
Whole Day
Meal Based
Variety B
Sun Rice
Napolitana penne
JACK LINK'S
ORIGINAL
BEEF JERKY
Skittles
Fruits
Cappuccino
MILO
CHOCOLATE RATION

DSTO-Scottsdale CONCEPT RATION

Whole Day - Meal Based

WD - MB

CONTENTS SHEET

Variety A	Serve Size
Toasted Muesli	2 x 50
Dried Skim Milk	2 x 3
Sustagen Sport, Chocolate	1 x 60
FD Meal Spaghetti and Meat Sauce	1 x 110
Sakata, Nacho Cheese	1 x 15
Tortellini, Mushroom and Bacon	1 x 350
Instant Beef Noodles	1 x 77
Tuna, in Springwater	1 x 85
Space Food Sticks, Chocolate	1 x 16.7
Ration Chocolate (SEMI DARK)	1 x 50
Musashi Protein Bar	1 x 90
Yoghurt Top Muesli Bar, Apricot	1 x 31.3
PowerBar Gel, Chocolate	1 x 41
Coffee Sachet, Cappuccino	1 x 12.5
Fruit & Nut Mix	1 x 65
Carmans Muesli Bar, Classic	1 x 45
Fruitip Pastilles	1 x 34
Starburst Fruit Chews	1 x 58
Beverage, coffee, instant	2 x 3.5
Beverage, tea bags	2 x 2.5
Sugar	4 x 7
Dried Skim Milk	2 x 3

Variety B	Serve Size
Toasted Muesli	2 x 50
Dried Skim Milk	2 x 3
Milo Drink Powder	1 x 20
Beef Jerky Pieces, Teriyaki	1 x 25
Vege Crackers, Honey Soy	1 x 25
Napolitana Penne	1 x 200
Instant Satay Noodles	1 x 80
FD Meal Beef Teriyaki	1 x 110
Space Food Sticks, Chocolate	1 x 16.7
Ration Chocolate (SEMI DARK)	1 x 50
Musashi Protein Bar	1 x 90
Yoghurt top Muesli Bar, Strawberry	1 x 31.3
PowerBar Gel, Apple	1 x 41
Coffee Sachet, Cappuccino	1 x 12.5
Fruit & Nut Mix	1 x 65
Carmans Muesli Bar, Original	1 x 45
Starburst Fruit Chews	1 x 58
Skittles	1 x 55
Endura Lemon Lime Drink	1 x 25
Beverage, coffee, instant	2 x 3.5
Beverage, tea bags	2 x 2.5
Sugar	4 x 7
Dried Skim Milk	2 x 3

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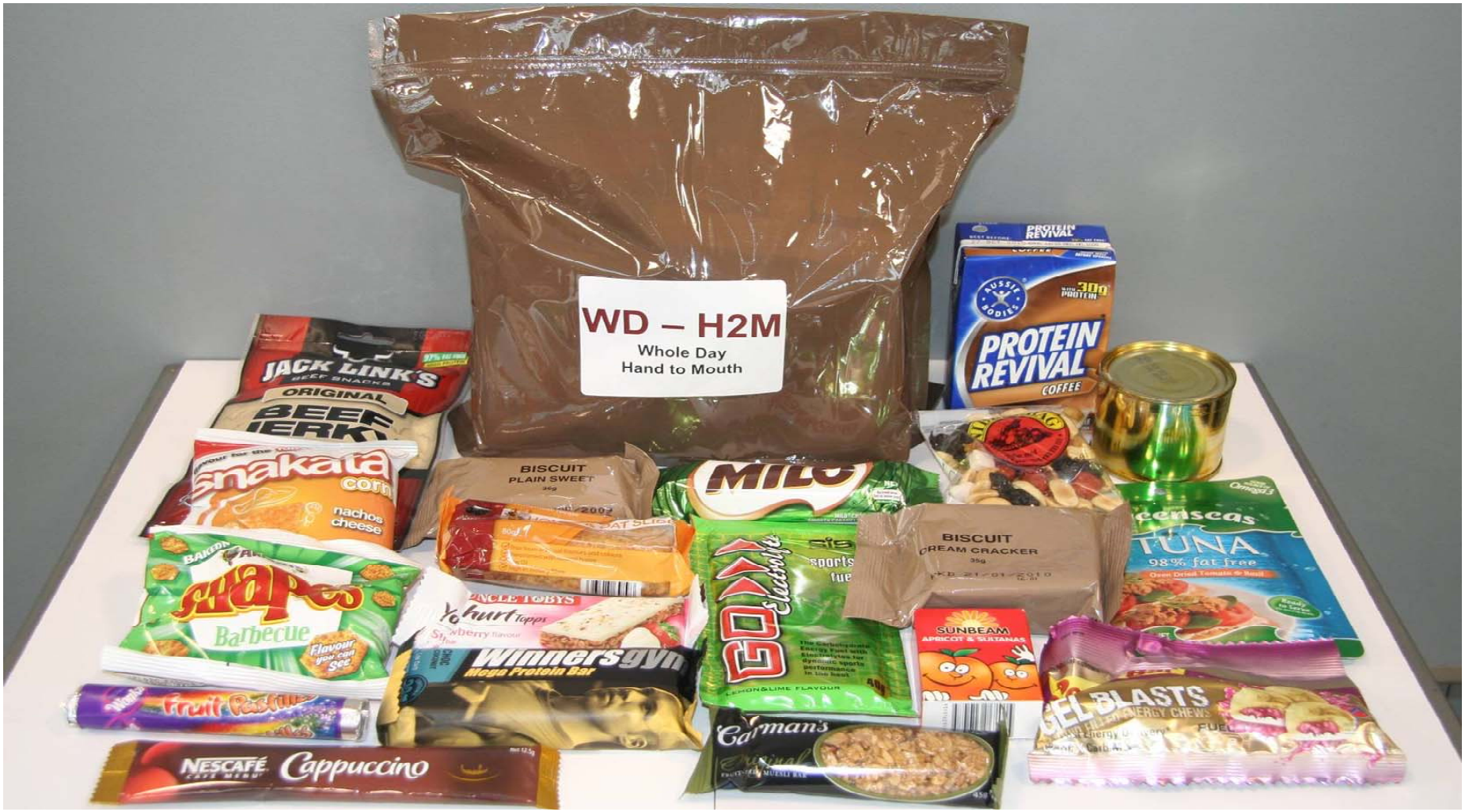
DSTO-Scottsdale CONCEPT RATION

Whole Day Ration - Snack Based, Hand to Mouth

	Recommended Nutritional Criterion for CRP		*Combat Ration One Man (CR1M)*		*Whole Day Ration (Snack Based, Hand to Mouth)*			
			Current		Goal		Concept	
Size (cm^3)	-		3570		3570		3600	
Weight (g)	-		1750		1750		1636	
Energy (kJ)	16,000		15,900		16,000		15812	
	g	% Energy Content	g	% Energy Content	g	% Energy Content	g	% Energy Content
Carbohydrate (g)	565-590	60-63%	624	65%	565	60%	519	56%
Protein (g)	122-150	13-16%	97	11%	140	15%	145	16%
Fat (g)	108-143	26-34%	116	25%	105	25%	120	29%

Legend:	
Meets goal (within 5%)	*green*
Positive departure from goal (more than 5%)	*light green*
Negative departure from goal (more than 5%)	*orange*


WD – H2M
Whole Day
Hand to Mouth
PROTEIN REVIVAL
COFFEE
JACK LINK'S
ORIGINAL
BEEF JERKY
smakata
corn
nachos cheese
BISCUIT
PLAIN SWEET
MILO
BISCUIT
CREAM CRACKER
Barbecue
Fruit Pastilles
Winnersgym
Mega Protein Bar
GO Electrolyte
SUNBEAM
APRICOT & SULTANAS
Carman's
NESCAFÉ Cappuccino
TUNA
98% fat free

DSTO-Scottsdale CONCEPT RATION

Whole Day - Snack Based - Hand to Mouth

WD - SB - H2M

CONTENTS SHEET

Variety A	Serve Size
Protein Revival Drink, Coffee	1 x 375
Peaches in Syrup	1 x 140
Biscuit, Plain Sweet	2 x 36
Tuna, Tomato & Basil	1 x 85
Biscuit, Cream Cracker	1 x 35
Power Bar, Gel Blasts Fruit Chews, Raspbe	1 x 60
Coffee Sachet, Cappuccino	1 x 12.5
Fruit & Nut Mix	2 x 65
Milo Bar	1 x 55
Carmans Muesli Bar, Original	1 x 45
Mega Protein Bar, Choc Coconut	1 x 75
Shapes, Barbecue	2 x 25
Sakata, Cheese Supreme	1 x 15
Go Sports Drink Powder, Lemon Lime	1 x 40
Beef Jerky Pieces, Original	1 x 50
Fruitip Pastilles	1 x 34
Yoghurt top Muesli Bar, Strawberry	1 x 31.3
Apricots & Sultanas	1 x 37
Honey & Oat Slice, Apricot	1 x 80

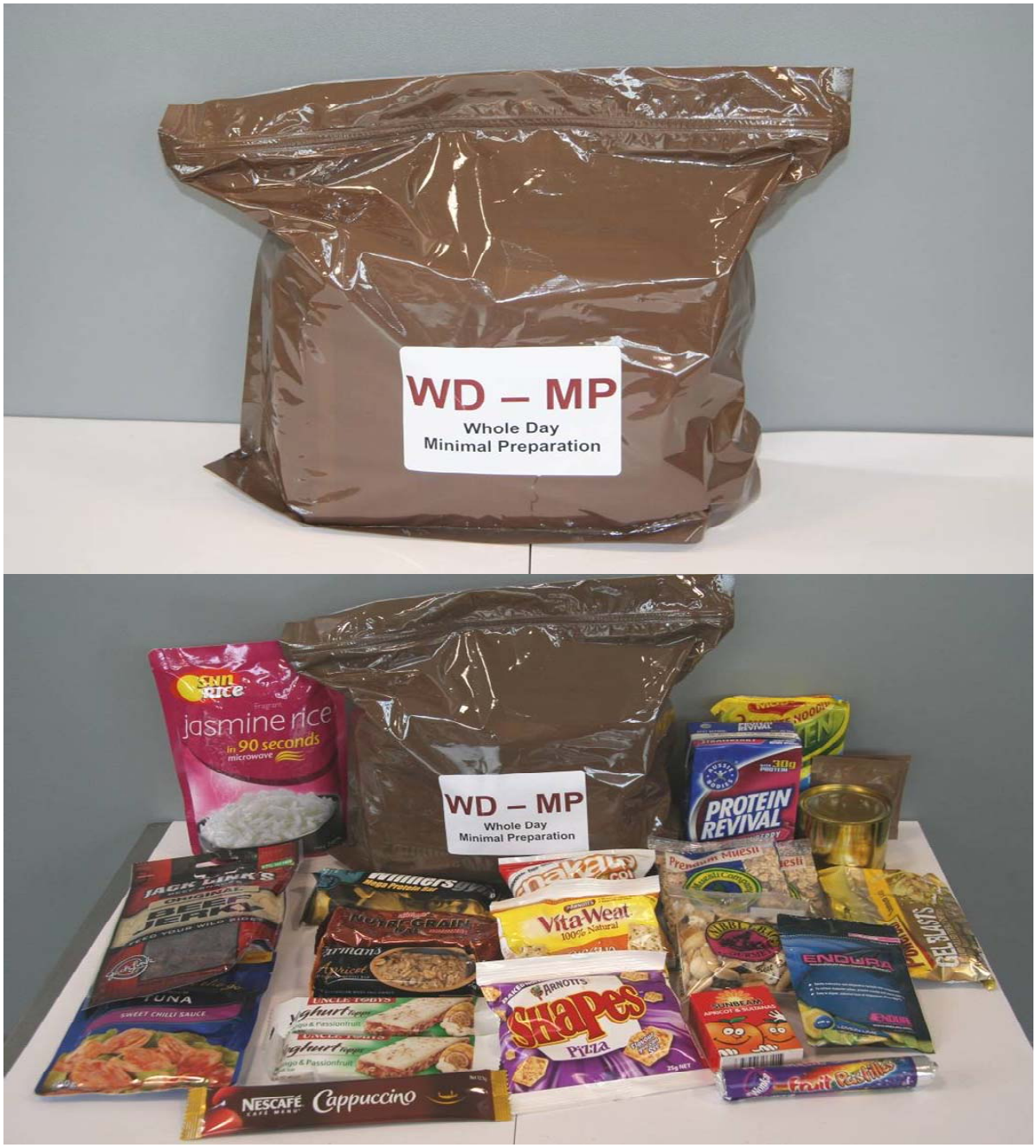
You can provide feedback on this concept to:
ration.packs@dsto.defence.gov.au

DSTO-Scottsdale CONCEPT RATION

Whole Day Ration - Snack Based, Minimal Preparation

	Recommended Nutritional Criterion for CRP		*Combat Ration One Man (CR1M)*		*Whole Day Ration (Snack Based, Minimal Preparation)*			
			Current		Goal		Concept	
Size (cm^3)	-		3570		3570		3450	
Weight (g)	-		1750		1750		1645	
Energy (kJ)	16,000		15,900		16,000		15567	
	g	% Energy Content	g	% Energy Content	g	% Energy Content	g	% Energy Content
Carbohydrate (g)	565-590	60-63%	624	65%	565	60%	573	63%
Protein (g)	122-150	13-16%	97	11%	140	15%	151	17%
Fat (g)	108-143	26-34%	116	25%	105	25%	84	20%

Legend:	
Meets goal (within 5%)	*green*
Positive departure from goal (more than 5%)	*light green*
Negative departure from goal (more than 5%)	*orange*


WD – MP
Whole Day
Minimal Preparation
WD – MP
Whole Day
Minimal Preparation
jasmine rice
in 90 seconds
microwave
PROTEIN REVIVAL
Vita-Weat
100% Natural
Arnotts
Shapes
Pizza
NESCAFÉ
Cappuccino
ENDURA

DSTO-Scottsdale CONCEPT RATION

Whole Day - Snack Based - Minimal Preparation

WD - SB - MP

CONTENTS SHEET

Variety A	Serve Size
Muesli, Fruit	2 x 50
Dried Skim Milk	2 x 3
Protein Revival Drink, Strawberry	1 x 375
Peaches in Syrup	1 x 140
Instant Chicken Noodles	1 x 76
Tuna, Sweet Chilli	1 x 100
Jasmine Rice	1 x 125
Power Bar, Gel Blasts Fruit Chews, Lemon	1 x 60
Coffee Sachet, Cappuccino	1 x 12.5
Fruit & Nut Mix	1 x 65
Nutri-grain Bar	1 x 30
Carmans Muesli Bar, Apricot	1 x 45
Mega Protein Bar, Choc Coconut	1 x 75
Grain Snacks, Cheddar & Chives	1 x 20
Sakata, Cheese Supreme	2 x 15
Endura Lemon Lime Drink	1 x 25
Beef Jerky Pieces, Original	1 x 50
Fruitip Pastilles	1 x 34
Yoghurt top Muesli Bar, Mango & Passionfru	2 x 31.3
Apricot & Sultanas	1 x 37
Honey & Oat Slice, Apricot	1 x 80

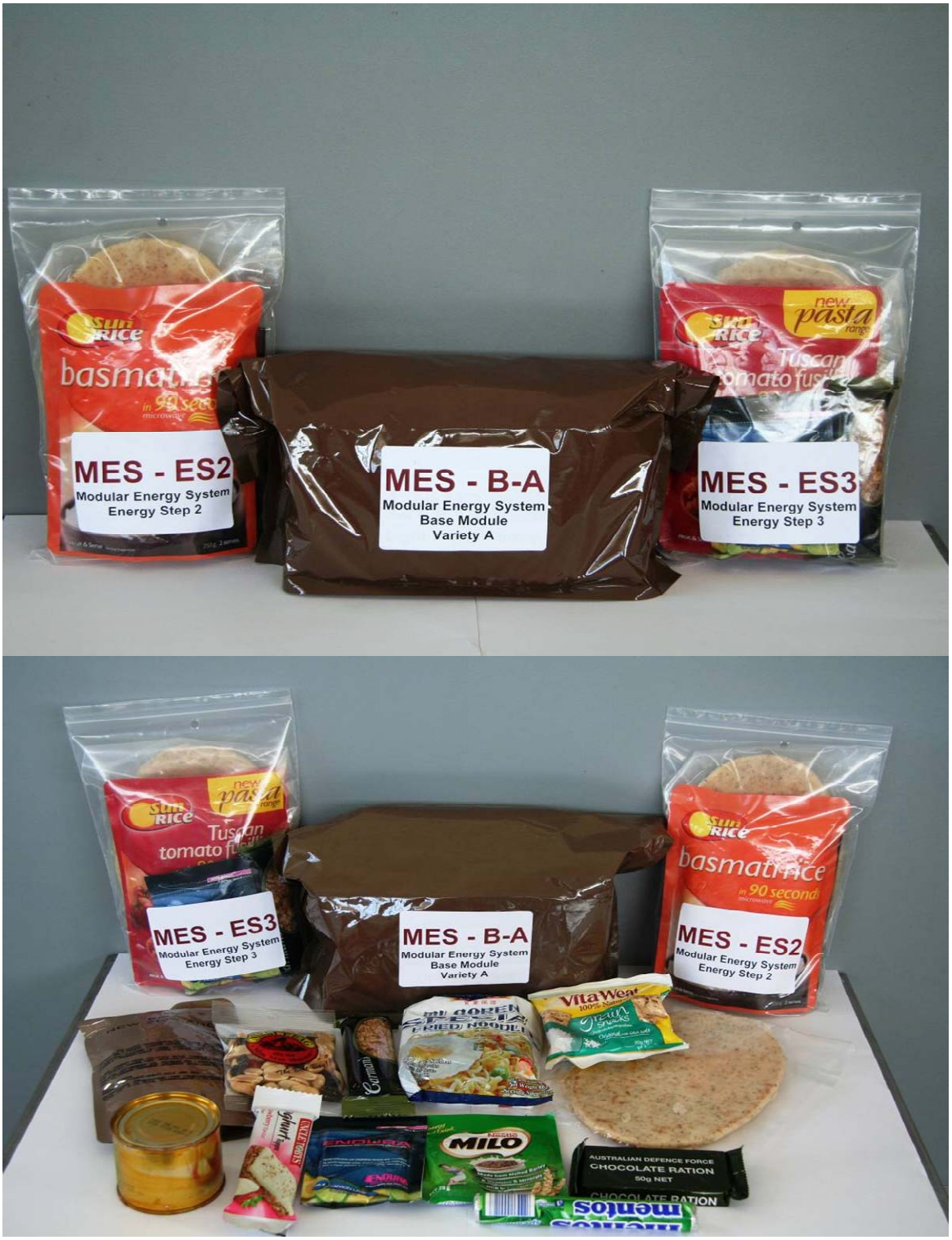
You can provide feedback on this concept to:
ration.packs@dsto.defence.gov.au

DSTO-Scottsdale CONCEPT RATION

Modular Energy System (MES) Ration

	Recommended Nutritional Criterion for CRP		*Combat Ration One Man (CR1M)*			*Modular Energy System (MES)*			
			Current			Goal (Base)		Concept	
Size (cm^3)	-		3570		Base + 1 ES	3570		3600	
Weight (g)	-		1750		Base Module	1250		1076	
					Energy modules	500		384	
Energy (kJ)	16,000		15,900		Base Module	12,000		11345	
					Energy modules	4,000		3797	
	g	% Energy Content	g	% Energy Content		g	% Energy Content	g	% Energy Content
Carbohydrate (g)	565-590	60-63%	624	65%	Base Module	424	60%	396	59%
					Energy modules	141	60%	137	61%
Protein (g)	122-150	13-16%	97	11%	Base Module	106	15%	70	10%
					Energy modules	35	15%	35	16%
Fat (g)	108-143	26-34%	116	25%	Base Module	81	25%	88	29%
					Energy modules	27	25%	21	21%

Legend:	
Meets goal (within 5%)	*green*
Positive departure from goal (more than 5%)	*light green*
Negative departure from goal (more than 5%)	*orange*


MES - ES2
Modular Energy System
Energy Step 2
MES - B-A
Modular Energy System
Base Module
Variety A
MES - ES3
Modular Energy System
Energy Step 3
MES - ES3
Modular Energy System
Energy Step 3
MES - B-A
Modular Energy System
Base Module
Variety A
MES - ES2
Modular Energy System
Energy Step 2
MILO
AUSTRALIAN DEFENCE FORCE
CHOCOLATE RATION
50g NET
mentos

DSTO-Scottsdale CONCEPT RATION

Modular Energy System

CONTENTS SHEET

Standard Provision → **Base Modules**

Variety A	Serve Size (g)		
Retort Meal Chilli Con Carne	1	x	250
Instant Oriental Noodles	1	x	74
Grain Snacks Cheddar and Chives	1	x	20
Carmans Muesli Bar Original	1	x	45
Yoghurt Top Muesli Bar, Strawberry	1	x	31.3
Peaches in Syrup	1	x	140
Fruit & Nut Mix	1	x	60
Ration Chocolate	1	x	50
Skittles	1	x	55
Milo Drink Powder	1	x	20
Endura Lemon Lime Drink	1	x	25
Flat bread (Naan)	1	x	70
Mentos	1	x	37.5

Variety B	Serve Size (g)		
FD Meal Veal Italienne	1	x	110
White Rice	2	x	125
Honey & Oat Slice, Lots of Fruit	1	x	80
Yoghurt top Muesli Bar, Apricot	1	x	31.3
Two Fruits in Syrup	1	x	140
Fruit & Nut Mix	1	x	65
Grain Snacks Sea Salt	1	x	20
Ration Chocolate	1	x	50
Starburst Fruit Chews	1	x	58
Milo Drink Powder	1	x	20
Endura Lemon Lime Drink	1	x	25
Flat bread (Naan)	1	x	70
Mentos	1	x	37.5

Add 1, 2 or 3 modules according to workload → **Energy Modules**

Energy Step 1	Serve Size (g)
Fruit & Nut Mix	1 x 65
Bulk Protein Bar	1 x 80
Winners Energy Gel Lemon and Lime	1 x 40
Grain Snacks Cheddar and Chives	1 x 20
Endura Lemon Lime Drink	1 x 25

Energy Step 2	Serve Size (g)
Flat bread (Naan)	1 x 70
Carmans Muesli Bar Classic	1 x 45
Fruitip Pastilles	1 x 34
Pasta Tuscan Tomato	1 x 200
Endura Lemon Lime Drink	1 x 25

Energy Step 3	Serve Size (g)
Skittles	1 x 55
Basmati Rice	2 x 125
Tuna, Lemon and Black Pepper	1 x 100
Beef Jerky Pieces, Teriyaki	1 x 25

Standard Provision → **Ancillaries**

	Serve Size (g)
Beverage, coffee, instant	2 x 3.5
Beverage, tea bags	2 x 2.5
Sugar	4 x 7
Dried Skim Milk	2 x 3
Sweetened Condensed Milk	1 x 85

You can provide feedback on this concept to:
ration.packs@dsto.defence.gov.au

Appendix B: Comments about the food items contained in the concept rations

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Tuna Pouched (Tomato & Basil, Spring water, Sweet Chilli, Lemon & Cracked Pepper) (PDR, LWR, WD-MB, SBR-EM, SB-MP, MES-ES3)	+ Popular item (collective agreement) + Good product-well received + High acceptability + Popular flavours (Lemon & Cracked Pepper and Sweet Chilli) + Request to include item in all ration packs + Substantiates a main meal-increasing the nutritional value and the level of satiety. - Unappealing when warm in the heat - Unpopular flavours (tomato & basil and spring water) - Flavour fatigue ☼ Request to increase variety of flavours in rations to prevent monotony, meet preferences and increase consumption rate ☼ Request to include chicken in a pouch ('Chop Chop' brand) which is a popular jack ration and would increase variety and prevent monotony
Biscuits, Crispbread (PDR, LWR)	+ Good flavour + Good structure (do not easily break) - Plain taste when eaten alone ☼ Include spreads—vegemite, jam, cheese
Nutri-grain Bar (PDR, SB-MP)	+ Great idea

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Fruit & Nut Mix (PDR, LWR, WD-MB, SBR-EM, SB-MP, MES)	+ Popular item (collective agreement) + High acceptability + Good idea + Good product, well received + Good source of protein and carbohydrate + Good source of 'healthy' unsaturated fats + Convenient, compact, eat-on-the-go snack + Suitable size to carry in webbing or pockets + High satiety + Currently used as jack rations - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - Once opened food must be consumed ☼ Include resealable ziplock in packaging - Concern about risk of allergic reaction (nuts) (*NB. Individuals with a food allergy are unlikely to be accepted into the ADF*)
PowerBar Gel (Tropical Fruit, Chocolate, Apple) (PDR, WD-MB)	+ Good product, well received + Good idea + Instant source of energy + Replaces electrolytes from sweat loss - Dislike taste (Tropical Fruit) ☼ Include a variety of flavours - Taste too strong (Chocolate) ☼ Substitute for a more subtle flavour
Carmens Muesli Bar (Original, Apricot, Classic) (PDR, WD-MB, SBR-EM, SB-MP, MES)	+ Popular item (collective agreement) + Good taste + Edible—improvement on current muesli bar + Currently used as jack rations + Good idea + Appealing - Prefer yoghurt top ☼ Include yoghurt- and non-yoghurt-top bars
Mentos (Mint) (PDR, MES)	+ Good product, well received + Prefer Mentos in comparison to PK gum + Good idea

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Endura Drink (Lemon Lime) (PDR, LWR, WD-MB, SB-MP, MES)	+ Good product, well received + Replaces electrolytes from sweat loss + Used to refuel and rehydrate in the field + Magnesium will assist with muscle cramps (*NB. there is little science behind this belief*) - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - Inadequate packaging—risk of rupture ☼ Sturdy packaging that withstands pressure - High sugar content, no perceived nutritional value ☼ Substitute with a product lower in sugar that also provides some nutritional benefit (e.g. vitamin C) - May cause intestinal upset *(NB. Consume product with adequate water)*
Jerky Steak Bar (BBQ, Peppered) (PDR, LWR)	+ Popular item (collective agreement) + Good product, well received + High acceptability + Consistently tastes good + Convenient, compact, eat-on-the-go snack - Once opened, the whole bar must be eaten ☼ Implement resealable ziplock packaging - Prefer jerky pieces over jerky bars - Dislike texture, difficult to chew
Scotch Finger (PDR)	+ Popular item (collective agreement) - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - Dry mouth feel ☼ Substitute with a sweet biscuit with cream or jam filling—Shrewsbury's or Tim Tams are popular - Poor structure—break easily (crumbs) ☼ Implement more robust packaging - Little or no perceived nutritional value
Growling Dog Bar (Chocolate, Berry) (PDR, LWR)	+ Good item + Good source of protein and carbohydrate + Convenient, compact, eat-on-the-go snack + Suitable size to carry in webbing or pockets - Dislike one flavour (Berry) ☼ Include a variety of flavours - Better brands on the market - Include savoury protein bars as an option

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Shots Cola Vanilla Gel (PDR)	+ Instant source of energy - Not enjoyable (collective agreement) - Inadequate packaging—risk of rupture ☼ Sturdy packaging that withholds pressure - 'Horrible' taste—flavour is too strong ☼ Include different types of subtle flavours
Yoghurt Top Muesli Bar (Strawberry, Apricot, Mango and Passionfruit) (PDR, WD-MB, SBR-EM, MES)	+ Edible, improvement from current muesli bar + High consumption rate + High acceptability + Good brand name (associated with high quality, consistency) + Currently used as a jack ration + Yoghurt top contains a source of calcium + Good taste and popular flavours + Softened with hot water or milk to form muesli
Skittles Fruits (PDR, LWR, WD-MB, MES)	+ Popular item (collective agreement) + High consumption rate + High acceptability + Preferred in comparison to chocolate pebbles + Enhances morale - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - High sugar content which is believed by many participants to promote thirst - Little or no nutritional value ☼ Substitute with a product lower in sugar that also provides some nutritional benefit
Cheddar Cheese (Canned) (PDR)	+ Popular item (collective agreement) + High consumption rate + High acceptability + Good product, well received + Request to include in all CRP - Dislike foreign packaging (not Australian) ☼ Produce Australian-made and packaged cheddar cheese for rations to enhance morale - Canned items increase load and waste carriage ☼ Substitute with processed cheese stick with plastic packaging—popular item
Biscuit, Cream Cracker (PDR, SBR-EM)	+ Good taste - Poor structure—break easily (crumbs) ☼ Implement more robust packaging

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
GU Energy Gel (Tri-Berry) (PDR)	♦ Soldiers were not prompted to comment on this product and did not voluntarily comment
Fruitip Pastilles (PDR, WD-MB, SBR-EM, SB-MP, MES-ES2)	+ Popular product (collective agreement) + Good taste + Instant source of energy - High sugar content, no nutritional value ☼ Substitute with a product lower in sugar that also provides some nutritional benefit
Beef Jerky Pieces (Original, Teriyaki) (PDR, LWR, WD-MB, SBR-EM, SB-MP, MES-ES3)	+ Popular item (collective agreement) + Good product, well received + High acceptability + High consumption rate + Resealable packaging, can be eaten as desired + Prefer jerky pieces over jerky bars + Easy to chew in comparison to jerky bar + Good brand (associated with high quality and consistency) + All flavours taste good + Request to include in all CRP + Good source of protein - Quantity is insufficient for a popular item ☼ Increase quantity in CRP
Oat Slice (Strawberry Yoghurt) (LWR)	+ Good product, well received + Good taste + Good source of carbohydrate and energy + Appealing—improvement from current bars + High satiety + Sufficient portion size + Yoghurt top contains a source of calcium
Sports Beans (Orange, Fruit Punch) (LWR)	+ Popular product (collective agreement) + Instant source of energy + Replace electrolytes from sweat loss + Good flavours (Orange and Fruit Punch) + Convenient, eat-on-the-go snack, light-weight + Prefer in comparison to fruit grains - Flavour fatigue ☼ Increase variety of flavours in CRP

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Ration Chocolate (LWR, WD-MB, MES)	+ Good when melted—increases palatability ? Opinion divided - Poor acceptance - Unpalatable ☼ Reformulate to improve palatability and increase consumption - Monotonous ☼ Include different types of chocolate - High rejection rate if blooming has occurred ☼ Improve logistics to reduce storage time and minimise blooming - Remove as a standard from all CRP - Too much chocolate in the ration packs ☼ One chocolate bar in each ration is sufficient or only include in every second ration pack ☼ Prefer M&M's in comparison to ration chocolate
Winners Energy Gel (Lemon and Lime) (LWR)	+ Popular product (collective agreement) + Used to refuel and rehydrate in the field + Convenient, eat-on-the-go, light-weight + Suitable size to carry in webbing + Durable packaging - Dislike taste/flavour ☼ Implement a variety of flavours
Tortilla Bread (LWR)	+ Popular item (collective agreement) + Great idea + Substantiates a main meal-increasing the nutritional value and the level of satiety. - Freshness on storage is questionable ☼ Improve logistics to reduce storage time and incorporate oxygen scavengers in packaging

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Milo Drink Powder (LWR, WD-MB, MES)	+ Popular item (collective agreement) + Good taste + Good product, well received + Utilised for breakfast or supper + Enhanced morale + Good brand name (associated with high quality, consistency) - Palatable if consumed with milk, but skim milk powder does not dissolve properly ☼ Improve skim milk formulation - Effort and time required to prepare drink ☼ Substitute with a chocolate powder that is quick and easy to prepare (add water only) - Difficult to quickly and completely dissolve chocolate powder (lumpy) ☼ Substitute with a chocolate powder that dissolves quickly and is ready to drink
Beverage Coffee Instant (Army) (LWR, WD-MB, MES-A)	- Terrible quality, taste ☼ Substitute with Nescafe premixed coffee
Beverage Tea Bags (Army) (LWR, WD-MB, MES-A)	♦ Soldiers were not prompted to comment on this product and did not voluntarily comment
Sugar (Army) (LWR, WD-MB, MES-A)	- Excessive quantity of sugar sachets in CRP—of little or no nutritional value ☼ Reduce the amount of sugar sachets and replace with nutritious, low-GI foods to sustain soldiers
Dried Skim Milk (LWR, WD-MB, SB-MP, MES-A)	- Never used, always discarded ☼ Improve quality or remove from CRP - Does not dissolve properly in hot or cold water and texture is thin, runny and dilute ☼ Improve formula so milk powder fully dissolves and texture is similar to fresh milk
Sweetened Condensed Milk (MES-A)	+ Popular item (collective agreement) + Preferred in comparison to skim milk + Increase quantity in CRP + Adds sweetness to plain meals - Product dries during storage (heat and sun) and texture becomes grainy and unpalatable ☼ Improve formula to prevent moisture loss - Packaging easily explodes—becomes sticky and messy which attracts insects (collective agreement) ☼ Implement more robust packaging

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Torq Bar (Raspberry and Apple) (LWR)	♦ Soldiers were not prompted to comment on this product and did not voluntarily comment
Endura Sports Gel (Citrus, Vanilla) (LWR)	+ Good product, well received + Good source of instant energy + Good flavour (Citrus) + Currently used as jack rations + Has merit in the field + Instant source of energy
Sauce Sweet Chilli (LWR)	+ Sweet Chilli, Tomato, and BBQ sauce are popular as they add flavour to bland meals + Request that Tabasco sauce and Worcestershire sauce (popular sauces) be reinstated in CRP - Inadequate packaging ☼ Package sauce in a resealable squeeze tube - Sachet is too small for a popular item ☼ Increase sachet size
Euphoria Nutritional Bar (Strawberry) (LWR)	+ Good source of protein + Used to refuel and rehydrate in the field + Easy to consume
Sultanas (LWR)	+ Popular item (collective agreement) + Good product, well received + Good idea
Almond & Yoghurt Sultanas (LWR)	+ Good product, well received + High acceptability + High consumption rate - Concern about risk of allergic reaction (nuts) (*NB. Individuals with a food allergy are unlikely to be accepted into the ADF*)

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Retort Meal (BBQ Beef) (LWR) Retort Meal (Beef Minced & Spaghetti) (LWR) Retort Meal (Chilli Con Carne) (MES)	+ All of the retort meals are disliked, yet these flavours are the best ones that are available - Unpopular product (collective agreement) - High rejection rate (collective agreement) - No enjoyment when eating, poor for morale - Majority of the retort meals are discarded ☼ Improve overall quality of the retort meals so they are appealing and enjoyable - Unappealing/unappetising/ unpalatable— presence of congealed fat, gristle and arteries - Meals leave an oil residue in the mouth which is undesirable and unappetising ☼ Reduce amount of fat, gristle, arteries in the ingredients to increase consumption rate - Inedible cold ☼ Design product to be eaten hot or cold - Poor quality ingredients (meat in particular) ☼ Improve quality of ingredients and include real pieces of meat instead of cheap offcuts
Toasted Muesli (WD-MB)	+ Popular item (collective agreement) + Good product, well received + High acceptability + High consumption rate + Request to include in all CRP + Palatable with water, milk, sweetened condensed milk or on its own as a snack + Convenient, eat-on-the-go and light-weight + Decent portion size (two 50 g packets) - Can use to make porridge if time permits ☼ Include natural and toasted muesli in CRP
Sustagen Sport (Chocolate) (WD-MB)	+ Good taste + Good source of protein + Similar to a protein shake, which is well liked - Dislike dessert flavour to drink with water ☼ Prefer fruit flavours such as Gatorade or Powerade to drink with water

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Sakata (Nacho Cheese, Cheese Supreme) (WD-MB, SBR-EM, SB-MP)	+ Good snack item + Good taste + Low glycemic index, slow release of energy - Quantity is too small (15 g) ☼ Increase quantity (30 g) - Little or no nutritional value - Inadequate packaging—easily crushed ☼ Implement more robust packaging
Space Food Sticks (Chocolate) (WD-MB)	+ Popular item (collective agreement) + Good product-well received + Currently used as a jack ration + Prompts positive feelings of nostalgia - Quantity is insufficient for a popular item ☼ Increase quantity in CRP
Musashi Protein bar (WD-MB)	+ Good idea + Good product + Good source of energy + Assists with preventing muscle wasting + Palatable when slightly melted in the heat - Dislike the taste (collective agreement) ☼ Investigate other brands with same concept
Coffee Sachet (Cappuccino) (WD-MB)	+ Popular item (collective agreement) + Good product + Great idea + Eliminates the need for sugar and milk + Minimal preparation, quick and effortless - Quantity is insufficient for a popular item ☼ Increase quantity in CRP
Starburst Fruit Chews (MD-MB)	+ Popular item (collective agreement) + Good taste + Instant source of energy + Small amount of sugar in CRP is OK; the current ration packs have too much
Vege Crackers (Honey Soy) (WD-MB)	+ Good taste - Inadequate packaging—easily crushed ☼ Implement more robust packaging

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Tortellini (Mushroom & Bacon) (WD-MB) Napolitana Penne (WD-MB) Pasta Tuscan Tomato (MES-ES2)	+ Popular item (collective agreement) + Good product, well received + High acceptance + High consumption rate + Suitable to eat hot or cold + Good source of carbohydrate + No presence of congealed fat, gristle and arteries which is present in retort meals + Good taste/flavours + Good brand name (associated with good quality/credibility) ☼ Prefer Heinz brand pastas (higher quality) ☼ Prefer pasta meals in comparison to retorts - Meat not present in all meals—majority of the soldiers want some kind of meat in their meal ☼ Select meat-based meals to meet preferences - Lack of variety (monotony) ☼ Include a variety of flavours and types of pasta (ravioli, penne, fusilli, spiral)
Instant Noodles (Beef, Satay, Chicken, Oriental) (WD-MB, SB-MP, MES)	+ Popular item (collective agreement) + Most popular brand is Mei Goreng (satay) ☼ Request to include in all CRP + Substantiates a main meal-increasing the nutritional value and the level of satiety. - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - Dislike taste/texture of 99% fat-free noodles ☼ Substitute with preferred normal-fat noodles
FD Meal Spaghetti and Meat Sauce (WD-MB) FD Meal Beef Teriyaki (WD-MB) FD Meal Veal Italienne (MES)	+ Popular item (collective agreement) + Good product, well received + Quality is far superior to wet retort meals + Light-weight and compact + Only appropriate if adequate time to prepare + High satiety + Spaghetti and meat sauce is the most popular - Requires effort and time to prepare - Water is required—increases load carriage ☼ Only utilise in infantry scenarios - Requires hot water to reconstitute properly ☼ Develop meal to reconstitute with cold water - Dislike Beef Teriyaki flavour ☼ Prefer inclusion of lamb and rosemary flavour

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Protein Revival Drink (Coffee, Strawberry) (SBR-EM, SB-MP)	+ Popular item (collective response) + Increases the variety in CRP + Great idea + Good source of protein + Good for recovery - Product in liquid form increases load carriage - Product is bulky and packaging may rupture ☼ Substitute with a protein powder formula or a protein bar to eliminate the risk of packaging rupture and to minimise load carriage
Peaches in Syrup (WD-MB, SB-MP, MES) Two Fruits in Syrup (MES)	+ Popular item (collective agreement) + Good product, well received + High acceptance + High consumption rate + Eaten in combination with muesli + Prefer peaches/two fruits over pears - Canned items lead to increased waste and load carriage ☼ Implement plastic packaging to reduce load
Biscuit, Plain Sweet (WD-MB)	♦ Soldiers were not prompted to comment on this product and did not voluntarily comment
Power Bar, Gel Blasts, Fruit Chews, (Raspberry, Lemon) (SBR-EM, SB-MP)	+ Refuel and rehydrate in the field + Good taste + Currently used as jack rations - Inadequate packaging—risk of rupture ☼ Implement more robust packaging - Flavour fatigue ☼ Increase variety of flavours, prevent monotony
Milo Bar (SBR-EM)	♦ Soldiers were not prompted to comment on this product and did not voluntarily comment
Mega Protein Bar (Choc Coconut) (SBR-EM, SB-MP)	+ Popular product (collective agreement) + Good product, well received + Prefer protein bar over muesli bar + Good source of protein, carbohydrate and energy + High satiety value + Convenient, compact and light-weight + Suitable size to carry in webbing or pockets + Nutrient dense + Currently used as jack rations

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Shapes (BBQ) (SB-EM)	+ Currently used as jack rations + Inclusion of a savoury snack versus sweet snack + Convenient, eat-on-the-go, carry in webbing + Good taste + Something different—variety is interesting - No perceived nutritional value ☼ Investigate fortification or improve formula - Inadequate packaging—may crush and break ☼ Implement more robust packaging
Go Sports Drink Powder (Lemon Lime) (SB-EM)	+ Good for patrols + Good for endurance
Apricots & Sultanas (SB-EM, SB-MP)	+ Popular item (collective agreement) + Good product—well received
Honey & Oat Slice (Apricot, Lots of Fruit) (SB-EM, SB-MP, MES)	+ Good product-well received + Visually appealing + Low GI—slow release of energy + Good taste + Convenient, eat on the go, carry in webbing + High satiety value + Good source of carbohydrate and energy + Suitable to substitute for a main meal + Adequate to sustain work for a long period
Natural Muesli (Fruit) (SB-MP)	+ Popular item (collective agreement) + Good product, well received + Utilised at breakfast + Palatable with water, milk, sweetened condensed milk or on its own as a snack + Used to make porridge if time permits - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - Time consuming to eat - Time consuming for the muesli to soften ☼ Substitute with Uncle Toby's quick oats which require less time and effort to prepare

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Jasmine Rice (SB-MP) White Rice (MES) Basmati Rice (MES)	+ Good idea + Substantiates a main meal-increasing the nutritional value and the level of satiety. + High satiety value + Good source of complex carbohydrates + Suitable to eat hot or cold + Minimal preparation - High moisture content increases load carriage ☼ Substitute with freeze dried rice - Plain white rice with no flavour (monotony) ☼ Include a variety of flavours or seasonings - Excessive portion size for one meal ☼ Reduce quantity or use resealable packaging
Grain Snacks (Sea Salt, Cheddar & Chives) (SB-MP, MES)	+ Convenient, eat-on-the-go snack + Suitable to carry in pockets or webbing + Appealing + Inclusion of a savoury snack versus sweet snack + Good taste - Little or no nutritional value ☼ Investigate fortification or improve formula - Inadequate packaging-may crush and break ☼ Implement more robust packaging
Flat Bread (Naan) (MES)	+ Popular item (collective agreement) + Good product-well received + Substantiates a main meal-increasing the nutritional value and the level of satiety. + Currently used as jack rations - Quantity is insufficient for a popular item ☼ Increase quantity in CRP - Texture is too thick to fold and easily eat - Size is too big for only one slice of bread ☼ Prefer tortilla wrap or mountain bread—easy to fold, more slices of bread for the same quantity
Bulk Protein Bar (MES)	+ Popular item (collective agreement) + Good source of protein and energy + Good taste + High satiety value - Quantity is insufficient for a popular item ☼ Increase quantity in CRP

Food Item (Flavour) (Present in these Concept Rations)	**Comments: Positive (+) Negative (-) Suggestion (☼) No Comment (♦)**
Winners Energy Gel (Lemon & Lime) (MES-ES1)	+ Good idea + Instant source of energy + Currently used as jack rations - Quantity is insufficient for a popular item ☼ Increase quantity in CRP ☼ Prefer the brand GU Energy Gel

Appendix C: Comments about existing CR1M items (not included in the concept rations)

Existing Ration Pack Items (Flavour) (Present in these Ration Packs)	**Comments: Positive (+) Negative (-) Suggestion (☼)**
Wet Retort Meals (Vegetable Curry) (Menu F, H) (Salmon and Pasta in Cheese Sauce) (Menu H) (Meatballs with Sweet and Sour Sauce) (Menu E) (Beef Minced with Tortellini) (Menu D) (BBQ Chicken) (Menu E)	+ Heats up in the sun—minimal preparation + All the retort meals are disliked—Beef Minced with Tortellini and BBQ Chicken are preferred over the other options - Very unpopular product (collective agreement) - High rejection rate (collective agreement) - Congealed fat, gristle and arteries in meat meals which is unappealing, unappetising, unpalatable - Meals leave an oil residue in the mouth which is undesirable and unappetising ☼ Reduce amount of fat, gristle, arteries in the ingredients to increase consumption rate - No enjoyment when eating, poor for morale - Majority of the retort meals are discarded ☼ Improve overall quality of the retort meals so they are appealing, enjoyable and palatable - Inedible cold ☼ Design product to be eaten hot or cold - Poor quality ingredients (meat in particular) ☼ Improve quality of ingredients and include real pieces of meat instead of cheap offcuts - Soldiers who are not vegetarian should not be issued vegetarian rations—they prefer meat-based meals ☼ Request for Menu H and F retorts to be a special order ☼ Substitute with Campbells soup or 'Thick n Chunky'
Muesli Bar (Tropical Fruit, Forrest Fruits, Apricot & Coconut) (Menu C, F, Additional Food Items)	- Unpopular product (collective agreement) - High rejection rate (collective agreement) - Unappealing, unappetising and unpalatable - Poor texture - Bland flavour - Taste old after long-term storage ☼ Substitute with Uncle Toby's muesli bars or any muesli bars that contain fruit, nuts or yoghurt

Existing Ration Pack Items (Flavour) (Present in these Ration Packs)	**Comments: Positive (+) Negative (-) Suggestion (☼)**
Beverage Sports Powder (Mixed Berry, Lemon & Lime, Cool Citrus, Raspberry, Citrus, Orange, Grape, Tropical) (Present in all menus)	+ Popular item (collective agreement) + Continue to include in CRP + Any electrolyte drink is appropriate in the field if it refuels and rehydrates the soldier suitably
Beverage (Chocolate Powder) (Present in all menus)	+ Quick and easy to dissolve and prepare - Unpopular item (collective agreement) - Dislike taste
Fruit Grains (Blackcurrant, Mixed Berry, Raspberry, Tropical, Apricot) (Menu B, C, D, E)	+ Popular item + Continue to include in CRP + Convenient, light-weight, carry in webbing - Real dried fruit pieces are preferred over concentrated fruit pulp ☼ Substitute with real dried fruit pieces
Fruit, Pears, Canned (Menu C and G)	- Unpopular item (collective agreement) ☼ Substitute with canned peaches or two fruits
Chocolate Pebbles (Present in all menus)	- Unpopular item - Cheap, poor quality Army version of M&M's - Very hard to eat ☼ Prefer M&M's-better overall quality, taste and texture. Reinstate in CRP.

Appendix D: Negative comments about the CR1M

Existing Ration Pack Issue	Comments: Negative (-) Suggestion (☼)
Paper Menu	- Unnecessary paper waste ☼ Implement innovative design—print menus on ration bag to save paper and reduce load carriage
Nutrition and Health	- Weight loss from muscle wastage is common - Concern that the nutritional value of the CRP is insufficient, which will affect physical wellbeing and has long term health consequences ☼ Improve the nutritional value of the CRP by introducing more low GI foods, limiting sugar-based snacks, reducing fat content and increasing the protein content of main meals
Waste	- Excessive quantity of packaging and therefore waste—unpleasant odour and increases load carriage ☼ Reduce the amount of packaging or implement biodegradable, light-weight packaging or use a modular system to minimise waste
Ration Feeding Period	- Monotony occurs if on the same CRP for a long period without fresh feeding—reduces morale, performance, endurance and motivation ☼ Improve logistics system to increase turnover ☼ Increase frequency of fresh feeding if possible ☼ Increase variety of menus or implement a modular system with a range of supplementary modules
CRP in General	- Do not allow flexibility ☼ Implement a modular rationing system - Ration items are not meeting preferences and up to two thirds of the CR1M are discarded ☼ Listen to and implement soldiers' suggestions, requests and preferences to increase acceptability and consumption
CRP Weight and Bulk	- Substantial size with heavy and bulky items ☼ Cyrovac food items CRP as a whole ☼ Use biodegradable, light-weight packaging
Hexamine Stove	- Requires too much time and effort to heat food - Use prohibited after dark ☼ Implement a flameless ration heater. These are currently used by the US Army in the MRE ration—require little effort and are easy to use

Existing Ration Pack Issue	**Comments:** **Negative (-)** **Suggestion (☼)**
Use by Date	- Majority of food items are past the *use by* date which reduces overall quality and appeal ☼ Improve logistics system to increase turnover and maximise food consumption within use by date
Toilet Paper	- Insufficient toilet paper ☼ Increase quantity of toilet paper
Sanitation/Hygiene	- Nothing appropriate in ration packs to clean hands etc between meals or after going to the toilet ☼ Include antiseptic alcohol wipes or gel
Army packaging (green, brown, i.e. camouflage)	- Army colour reduces morale and increases rejection because it is not visually appealing and Army food is associated with poor quality ☼ Retain commercial packaging as it is appealing, enhances morale and increases acceptability
Brand Name	- Army is known for taking a popular commercial product and attempting to formulate the same product for a cheaper price, yet the overall quality of the product is poor and it is rejected - Brand recognition entices the consumer to eat the food. This does not occur with Army packaging ☼ Include the original commercial brand products
Australian Made	- Some of the food items in the ration pack are not produced and packaged in Australia, which is poor for morale and the Australian economy ☼ Source all ingredients from Australia, manufacture and package product in Australia (*NB. this is not possible under the current system of open tender within New Zealand and Australia)*
Field Ration Eating Device (FRED)	☼ Include in all ration packs even if there are no canned items. It is always useful for something
Retort Packaging	☼ The nick on the side of the retort package to assist with opening would be more useful on the other side of the package (longways). The spoon can then reach the bottom of the package, the contents can be thoroughly mixed and food does not spread up the spoon handle

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Food, Combat Rations, Nutriton, Diet, Acceptability

19. ABSTRACT

Increasingly demanding operational situations, combined with under-consumption of ration pack items, questions the suitability of current CRP for modern warfare. A project was conducted to explore user perspectives and the potential for possible alternative ration pack configurations. Six ration concepts were developed; two lightweight options, two whole day options; and a modular option. The evaluation of these ration concepts revealed that four were considered promising and worthy of further development. Three courses of action are identified—improving the current CR1M, introducing lightweight options and developing modular rations. It is recommended that 1) the merits of each of these actions be investigated; and 2) a case be developed for each of these options to be pursued in series—progressing from improvements to the existing CR1M, to the introduction of light-weight options (which may become modules), then finally to modular rations.