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Influences on the Consumption of Australian Ration Packs: Review of a Contextual Model and Application to Australian Defence Force Data

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ABSTRACT

Poor consumption of ration packs by Australian soldiers is common. Influences on consumption were investigated using a Three Factor Model – the food, the individual (soldier) and the environment (field). Previously collected Australian ration pack consumption data was examined under the structure of the model. Although the primary purpose for collecting the Australian data had been to determine acceptability (a food factor) variables from all three factors were observed, most commonly quality/acceptance, portion size, convenience, variety and appropriateness. Other variables were not investigated and some warrant further research. Recommendations are given for addressing some variables through ration design and other through future research.

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Executive Summary

It might be assumed that soldiers will consume sufficient food to match their energy expenditure; however research indicates that soldiers do not consume ration packs in their entirety, with energy intake regularly falling short of energy expenditure, increasing the chance of decline in both physical and cognitive performance.

The motivations to eat (or not to eat) are not necessarily well understood. It is crucial for us to gain an understanding of this to align ration pack design with the desires and motivation of the consumers and positively influence ration pack consumption.

A Three Factor Model – the food, the individual (soldier) and the environment (field) – was used to organise variables involved in the eating context. A review of Australian ration pack surveys was conducted to uncover which variables were evident in the existing data and which warrant further investigation. Although the primary purpose of the surveys was to examine acceptability – one variable within the food factor – variables from all three factors were observed. The most common variables found were – quality/acceptance, portion size, convenience, variety and appropriateness.

Before our next efforts in ration pack design it seems essential to consider three questions – what variables influence consumption, what do we already know about the impact of these variables and what variables are worthy of further investigation.

In terms of *food* – analysis of acceptability and consumption data suggested a weak correlation at best. Ration design should continue to maximise the acceptability of ration foods as well as providing main meals that are appealing when eaten hot or cold, ensuring compatible items are present and maximising variety within and across menus. Portion size could be increased which may result in higher consumption.

In terms of *soldiers* – little data was found and further investigation is warranted to determine soldier preferences and dietary influences. Including familiar brands may lift expectations of ration food and in turn increase acceptability and consumption. Consideration should be given to utilising social facilitation and social modelling where practical to increase consumption.

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In terms of the *environment*—feeding in the field differs greatly from the normal eating situation, and rations should be designed for this environment. Findings suggest they should be robust, reasonably light and not require excessive amounts of water for preparation. Meals or snacks need to be quick and easy to prepare and eat, and waste should be kept to a minimum, to make the experience convenient. We need to resolve whether camouflage packaging is essential and whether snack-based or meal-based rations are preferred and ultimately consumed well.

Recommendations are given for addressing these variables through ration design and further research.

Underconsumption of ration packs is a common problem. Food is fuel for a soldier's body and we need to optimise consumption to ensure soldiers perform at their best. The findings from this review give us guidance for future ration design, and investigation of the other variables described in the Three Factor Model will provide further guidance.

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1. Introduction

Current doctrine stipulates that for Australian Defence Force (ADF) feeding, as far as practicable “the rationing plan should ... provide for the use of fresh foodstuffs and organised messing. Where this is impracticable, fresh foodstuffs are partly or completely replaced by CRs (combat rations)” (Department of Defence 2009). Further, “CRP (combat ration packs) are designed to provide ADF personnel with enough nutritional sustenance to satisfy the daily requirement” (ibid). The daily energy expenditure of soldiers during typical field exercises has been reported at 15-16 MJ, so the energy availability for CRP has been set at 16 MJ (Forbes-Ewan 2009).

Research indicates that when fed with Combat Ration Packs (CRP), soldiers do not consume the CRP in their entirety discarding many items (Forbes-Ewan *et al.* 1988, Forbes-Ewan 2001, Carins 2002, Booth *et al.* 2003). The almost universal finding is that they do not consume sufficient quantities of their rations to balance energy intake with energy expenditure. As a result, they lose weight. This underconsumption and resulting energy imbalance are associated with an increased likelihood of decline in both physical and cognitive performance. In operational situations this decline may result in critical errors in judgement or diminished performance that may result in failure to achieve the mission, or risk the personal safety of the individual or those around them.

It might be assumed that soldiers will consume sufficient food to match their energy expenditure and to maintain energy balance. This assumption stems from the theory of homeostasis, where physiological processes ensure that humans eat enough food to maintain short-term energy needs and long-term regulation of a fairly constant body weight. During field exercises soldiers often do not meet short-term needs, with energy intake regularly falling short of energy expenditure by as much as 10-50% (Baker-Fulco 1995, Mudambo, Scrimgeour and Rennie 1997, Booth *et al.* 2003). Generally, this deficit is recovered when soldiers return from the field and can freely eat freshly prepared foods.

Unfortunately, the motivation to eat (or not to eat as the case may be) is not well understood. It is tempting to assume that soldiers will eat their rations ‘if they are hungry’ or ‘if they like them’. However, the evidence suggests that this may be an oversimplification of the situation.

It is important to gain a good understanding of the behavioural aspects of eating if we wish to positively influence ration pack consumption, and indeed healthy eating habits in general. It is also crucial to have an understanding of this behaviour in order to steer ration pack design in a direction that aligns with the desires and motivation of the consumers and provides the sustenance that they need.

This literature review was conducted to analyse information from past Australian military ration pack surveys and trials, in order to identify possible reasons for reported underconsumption. Many of the surveys have previously given us insight into the acceptability or ‘liking’ of particular food items, and have influenced menu design and product choice. This review aims to investigate what other factors the surveys revealed, what the implications are for future ration pack design, and for further investigation of the eating behaviours exhibited by ADF members.

1.1 Background

Theories of food choice – which encompass both the choice *to* eat and the choice of *what* to eat – examine the factors that influence eating behaviour. This type of research assumes that eating is not just a simple decision to consume foods containing a range of nutrients, at a particular time, to satisfy a desire and sustain our bodies. Physiological signals (hunger), sensory appeal (taste), learning/experience, social factors (e.g. religion, class, culture, education and familiarity), cost, convenience and many other factors influence our food choices.

Product developers are interested in factors that will increase the likeability or desirability of a product, resulting in their product becoming more likely to be chosen. Health professionals are interested in how people choose foods from a range of alternatives and how that ultimately affects their health. Consumption of food from military field rations is a different situation again. The food is provided – there is little or no choice – and often the food may be presented in a different form to that normally encountered, typically as long-shelf-life food with very plain packaging.

Dr Herbert Meiselman, an expert in the fields of sensory and consumer research, and formerly a research psychologist with the US Army Natick Soldier Systems Center has a long-standing research interest in the contextual or situational aspects of eating. He proposed a model based on three factors – the *food*, the *individual* and the *situation/environment* – to organise the variables involved in the eating context (Meiselman 1996). This model is based around the concept that *food* is consumed by *individuals* in a particular *environment*, and that the context – the set of events and experiences that are not part of the actual eating but have some relationship to it – will have a bearing on the actual eating itself (Rozin and Tuorila 1993).

Recently this Three Factor Model has been applied to the consumption of ration packs, with the aim of determining which variables may increase or decrease ration consumption (Meiselman 2010). Table 1 shows the factors and the variables within each factor in Meiselman's Three Factor Model.

By using this model – the food (ration), the individual (soldier) and the environment (field exercise or operation) – we were able to systematically examine past Australian studies of ration pack consumption and acceptability.

Table 1: Meiselman's Three Factor Model and variables

Food	Individual (Soldier)	Environment (Field)
▪ Portion size	▪ Age	▪ Appropriateness
▪ Food temperature	▪ Gender	▪ Time of day
▪ Food compatibilities	▪ Expectations	▪ Choice
▪ Food quality/acceptance	▪ Religious influences	▪ Location
▪ Food packaging and labelling	▪ Other dietary influences (e.g. vegetarianism)	▪ Temperature/weather
▪ Packaging effort	▪ Traits and attitudes	▪ Speed of eating/eating duration
▪ Food presentation	▪ Cross-cultural food and dietary preferences/aversions	▪ Convenience
▪ Food variety/monotony	▪ Commensality	▪ Price/value/free food
▪ Sensory-specific satiety	▪ Moods and emotions	
▪ Food authenticity/country of origin	▪ Satiety	

2. Methods

A literature review was conducted of reports and surveys of CRP acceptability and consumption carried out by the Australian Department of Defence dating back to 1961. A list of the reports, together with a brief description of each report, is shown in Appendix A.

A total of 36 reports were reviewed, with the number of reports addressing each ADF combat ration as follows:

- Combat Ration One Man (CR1M) - 12
- Patrol Ration One Man (PR1M) - 9
- Group feeding ration: Combat Ration Ten Man (CR10M), or Combat Ration Five Man (CR5M) - 6
- Special purpose combat rations, e.g. Training Ration, prototype Hot-Weather Ration (HWR), prototype Light-Weight Ration (LWR) and Emergency Flying Ration (EFR) - 5
- Individual Meal Combat Ration (IMCR), a CRP that was developed in the 1980s and discontinued in the 1990s - 2
- Unspecified ration types - 2

Most surveys were conducted during field exercises, where the soldiers were consuming the rations. Details of how consumption was measured in each study is given in Appendix B.

The aim of the current review was to identify common reasons for the under consumption of rations. Each report was examined for findings relating to the variables described in the Three Factor Model. Variables that emerged repeatedly were identified, as were areas which had not previously received any attention.

It needs to be kept in mind that the design of each reviewed study or survey was not based on the model. Generally, the main design focus was acceptability of individual products (ratings of liking) or acceptance of the ration (inferred from consumption data). For this review, the reports were examined to determine if any variables from the model had been uncovered in the course of the research, and to compare the findings of the reports.

Where discard rates, consumption rates, acceptability scores and ratings of demand were given for each item, they were extracted to enable comparisons across studies. SPSS Statistics 17.0 was used to perform statistical analyses. Means and standard deviations (SD) and 95% confidence intervals (95% CI) were calculated. Percent discards and reported consumption were rescaled to determine calculated percent consumption. Acceptability results were rescaled to consistently follow a scale of 1 to 5. Comparisons were made between consumption data and acceptability and demand. Patterns in consumption rates over the years were examined. Regression analysis was performed to determine whether acceptability is a predictor of reported or actual consumption. Comparisons were made over time, and across types of ration items.

3. Results

Examination of past Australian surveys and studies of ration pack usage found that variables of all three factors have been observed to affect ration pack consumption. Many of the reports and surveys did not directly examine the variables—recall that none of the studies were designed based on Meiselman's Three Factor Model—instead they pursued a line of questioning related to one or two variables. Information about variables was often revealed in the additional comments or free text answers from participants.

The majority of the surveys tested consumer acceptability (liking) and service suitability (fit for purpose) of the various ration packs. Variables concerning the food and the environment received more research attention than the individual/soldier. Many of the questions concerning the food and the environment were found to align with the variables in Meiselman's model, however the design of the surveys did not allow for detailed examination of the individual/soldier variables as described by Meiselman (2010).

Results were tabulated to determine which variables were commonly identified and which were not (see Appendix C). Descriptive notes of the findings in each report can be found in Appendix D. The most commonly studied variables were quality/acceptance, portion size, convenience, variety and appropriateness. Results for individual variables are reported below.

3.1 The Influence of Variables related to the Food on CRP Acceptability

3.1.1 Portion size

In 27 of 36 studies (75%) soldiers were asked if they thought they had adequate quantities of each item in their ration pack. The standard question format was:

Item X Amount provided: 1) Not enough 2) Enough 3) Too much
Generally the findings were positive, with the majority of rations considered to provide enough food overall, and most responses for individual items fell into the *enough* category.

Twelve reports listed items that soldiers felt were provided in insufficient quantities (Hutchinson 1962, Smith 1964, Smith 1965, Younger 1966b, Hutchinson, Gillis and Hope 1971, Badcock and Lichtenstein 1978, Lichtenstein 1979b, Lichtenstein 1979a, Lichtenstein and Venkata-Raman 1979, Badcock 1985, Forbes-Ewan and Waters 1987, Forbes-Ewan 2001). Most of these reports stated that the rations did not contain enough brew gear (coffee/tea, sweetened condensed milk and sugar). Items that were listed less often were main meals¹, snacks, biscuits, cheese, drink powders, rice, canned fruit, chocolate, bread, pudding, cake, dried vegetables, and dried fruit.

In most instances, rations were considered to have sufficient food overall. Three rations were considered to have insufficient food, a Prototype Patrol Ration containing ~11 700 kJ (Smith 1965), a Combat Ration One Man containing ~14 000 kJ (Forbes-Ewan and Waters 1986) and most recently a Combat Ration One Man containing ~15 000 kJ (Forbes-Ewan 2001).

3.1.2 Food Temperature

Ten reports discussed the issue of heating foods, or having food at the right temperature for consumption. Being able to heat food items was important to the majority of respondents, and most were able to heat foods at least some of the time (Forbes-Ewan 2001, Carins 2002). Main meals were found to be unpalatable when cold (Dowman, McLelland and Reck 1970, Forbes-Ewan and Waters 1986, Driver *et al.* 1996, Stephenson, Cavanough and Driver 1998), a finding that is supported by recent investigations (Carins, unpublished data). Many considered it was important for main meals to be able to be eaten cold (Dowman, McLelland and Reck 1970, Forbes-Ewan and Waters 1986, Probert, Bandara and Jayasena 2010), and in one study a clear desire was expressed for a main meal that could be eaten cold (Stephenson, Cavanough and Driver 1998). In a recent study, main meals that were designed to be eaten cold were more acceptable and had a higher consumption than other meals (Kullen *et al.* in preparation).

3.1.3 Meal Components and Food Compatibilities

The structure of rations – either meal components or food compatibilities – was examined in eleven reports. There were requests for specific breakfast items (Forbes-Ewan and Waters 1986, Carins 2002). Main meals were popular; there were data suggesting that a menu composed entirely of snacks would be inappropriate (Driver *et al.* 1996) and there were requests for the inclusion of three meals when the ration contained only two (Hutchinson, Reck and McLelland 1970). On the other hand, one report proposed the adoption of a midday snack, and a snack-based ration was found to be more acceptable than a meal-based ration in two studies (Rayner ~1966, Kullen *et al.* in preparation). In one survey, spreads provided in

¹ Main meals refer to food items, generally casserole style meals, that form the main part of a meal. They may be eaten without accompaniment (e.g. Spaghetti Bolognese) or with complimentary food items (e.g. BBQ Beef might be consumed with rice or noodles)

the CR5M were found to be of no use, because a cereal supplement was not provided regularly (Driver *et al.* 1996).

3.1.4 Food Quality and Acceptance

All reports included details of the acceptability of the items contained in the ration packs of interest (see Appendix C, part a). Most surveys asked the participants to rate the quality, liking for, or acceptability of items using an hedonic scale.

Common reasons for not liking or rejecting food included observations that they were *too salty, too fatty or too bland* (Younger 1964, Badcock and Lichtenstein 1978, Forbes-Ewan and Waters 1986, Forbes-Ewan 2001). There were also issues with the reconstitution of meat when using freeze dried meals (Younger 1964, Badcock and Lichtenstein 1978, Lichtenstein and Venkata-Raman 1979). Sometimes the meat was still hard in the middle, which was seen as unacceptable by the participants. It was found that during long deployments, acceptability dropped as the length of time consuming the rations increased (Forbes-Ewan 2001).

Individual items were consistently found to be greatly liked or greatly disliked in these reports. Sweetened condensed milk was a popular and acceptable item in almost every survey. Other popular items were cheese, sweet biscuits, confectionery, fruit items (canned fruit and dried fruit) and rice (but only in older surveys – rice has not been popular in recent times). Conversely, many main meals and meats have been criticised, mainly due to the selection of poor quality ingredients. Meats were perceived to be fatty, tough or containing large amounts of gristle. Other disliked items were egg dishes, curry powder, butter concentrate, soup, fruit drink powders, potato and onion powder and freeze dried rice (in more recent surveys). See Appendix D.1 for further detail.

3.1.5 Food Packaging and Labelling

In 20 of the 36 surveys (56%) questions were included to investigate the effect of changes to the packaging. Some of the reported findings fit best under the variables of appropriateness and convenience, and have been addressed in those sections (Sections 3.3.1 and 3.3.4).

Meiselman's model discusses packaging and labelling in the food context in terms of names, labels and brands. These types of issues were not investigated in the work examined, except for one report proposing the inclusion of nutrition information on the packaging of the ration items to allow the user to make more informed discards (Forbes-Ewan and Waters 1986).

3.1.6 Variety and Monotony

Limited variety in the rations was a complaint in 20 of 36 reports (56%). A need for more variety in the rations was expressed, or that the current foods were monotonous in one or more of taste, texture and appearance. Biscuits, sweets and main/meat meals were particularly mentioned as being monotonous (see Appendix D.1 for further detail).

3.1.7 Remaining Variables

The four remaining variables – packaging effort, food presentation, sensory-specific satiety and food authenticity/country of origin – were not explored in depth in any of the reports.

3.2 The Influence of Variables related to the Individual on CRP Acceptability

The individual, or soldier, was the least researched factor. Despite this, some findings did emerge. Younger soldiers were found to dislike kidney, offal and the egg dishes (James and Row 1970, Forbes-Ewan and Waters 1987), a finding that relates to the variables age and preferences. Increasing support for vegetarian menus was seen (Forbes-Ewan 2001, Carins 2002) and rations were designed at one point to be acceptable to both Australians and Pacific Islanders (Smith 1965, Younger 1966b), findings that fit under the variable of cultural or dietary influences.

Group influence (part of commensality) was suspected to have contributed to a higher-than-usual rate of return of meat blocks from one group, the researchers noting that “several of them were very outspoken in expressing their dislike of the meat blocks to the project officer. No doubt they were even more outspoken to their companions” (Hutchinson and McNaughton 1961). Some researchers examined satiety, finding that either the rations achieved (Hutchinson 1962, Dowman, McLelland and Reck 1970) or failed in this respect (Hutchinson and McNaughton 1961, Smith 1965, Hutchinson, Gillis and Hope 1971).

There were no findings related to gender, religious influences or traits/attitudes.

3.3 The Influence of Variables related to the Environment on CRP Acceptability

3.3.1 Appropriateness

The research reviewed did not specifically examine appropriateness of the food included in CRP to the environment although some findings could be interpreted as relevant to this variable. Many of these related to how appropriate rations were to situations, for example when water supply was limited (Stephenson, Cavanough and Driver 1998). Lightweight options were considered appropriate for some groups (Driver *et al.* 1996, Stephenson, Cavanough and Driver 1998).

Early studies contained reports of pouches and packages rupturing and leaking, tainted food and requests for stronger packaging (Younger 1966b, Younger 1967b, Poole 1968, Dowman, McLelland and Reck 1970, James and Row 1970, Badcock and Lichtenstein 1978, Lichtenstein 1979a, Rayner ~1966). The potential for packaging to compromise a soldier’s position was also a concern, with packaging considered too noisy, shiny or lacking camouflage (Badcock and Lichtenstein 1978, Lichtenstein 1979b, Stephenson, Cavanough and Driver 1998, Forbes-Ewan 2001).

3.3.2 Choice

Choice was not broadly examined in the trials and surveys. Two trials did allow for choice of food items (Younger 1964, Booth *et al.* 2001). Both these reports tested low-energy rations (providing one half or two thirds of the energy that is regularly provided in rations). The element of choice was introduced in the hope that soldiers would consume as much of the ration as possible, however there were still significant discards.

3.3.3 Temperature/Weather

Few reports made comparisons based on weather or climate. Those soldiers who consumed the CR1M in a hot climate rated it less acceptable and consumed less of it than soldiers rationed with the CR1M in temperate climates. It was also noted that the ration chocolate tended to melt, and there were too many hot drinks (Carins 2002). Conversely hot drinks and soup appeared to be acceptable in the heat in two studies (Badcock 1985, Forbes-Ewan and Waters 1987). When a ration that was specifically designed for hot weather was consumed in a hot environment, it was found to be more acceptable than the existing CR1M (Kullen *et al.* in preparation).

3.3.4 Speed of Eating/Eating Duration

Two reports found that there was a lack of time to eat, or that meals had to be rushed (Stephenson, Cavanough and Driver 1998, Kullen *et al.* in preparation). Many other reports made reference to specific items taking too long to prepare, but these have been dealt with under the convenience variable.

3.3.5 Convenience

Inconvenient aspects of rations were identified in many reports. The most common complaints were in regard to the time required to prepare meals, and load carriage of either rations or the water needed to reconstitute dried items.

Boxed matches were found to break too easily, became damp and were hard to light (Poole 1968, Stephenson, Cavanough and Driver 1998). The release of vial matches has helped rectify this problem (McLaughlin and Thomson 2002). Another complaint was that the plastic spoons break too easily (Stephenson, Cavanough and Driver 1998). Although individually these may be only minor inconveniences, they can combine to cause a substantial inconvenience collectively, resulting in difficulties in preparing and then consuming meals.

Changes in packaging have also resulted in ration pack items that are easier for the soldier to use or carry. The removal of cans (in favour of retort pouches or freeze dried meals) was well received (Driver *et al.* 1996, Carins 2002). On the negative side, the contribution of the packaging to waste was also noted (Hutchinson, Gillis and Hope 1971, Forbes-Ewan and Waters 1986, Stephenson, Cavanough and Driver 1998), although there was no indication that this problem has increased due to changes in packaging over time.

3.3.6 Remaining Variables

Time of day/meal patterns, location, and price/value/free food were not examined in any of the reports.

3.4 Patterns in Consumption, and Comparison with other Measures

Two methods of recording consumption were used in these reports – counting discarded items ('percent discards') and reporting the amount of an item consumed ('reported percent consumption'). Percent discards demonstrated a 'flooring effect', due to a large number of early studies that reported a very low level of discards (Figure 1a). More recent studies that examined reported percent consumption displayed approximately normal distributions (Figure 1b).

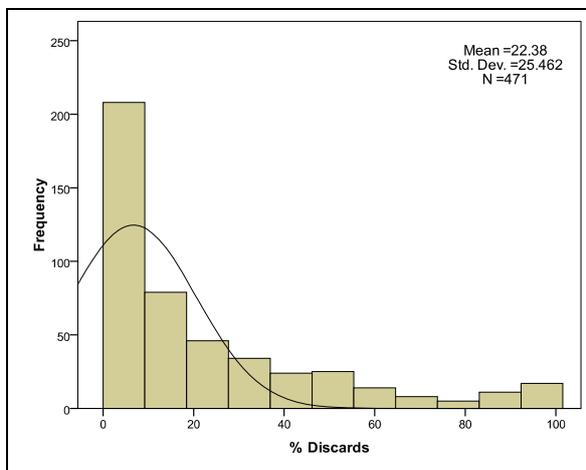


Figure 1a: Mean % discards for all ration items (8 studies)

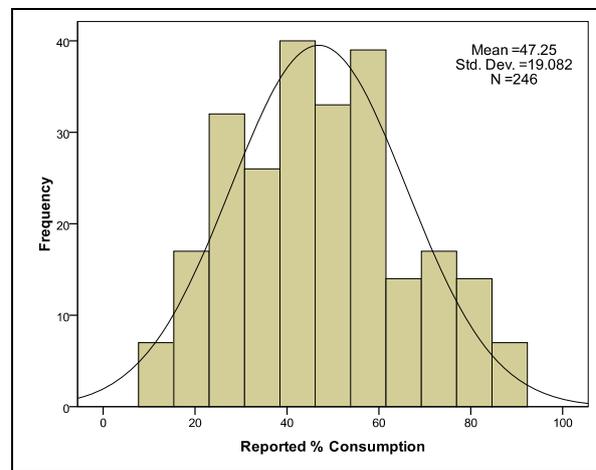


Figure 1b: Mean reported % consumption for all ration items (4 studies)

To compare data from the two different methods, a variable – 'calculated percent consumption' – was created where, depending on the method used:

$$\begin{aligned} & \text{Calculated percent consumption} = 100 - \text{percent discards;} \\ \text{or} & \quad \text{Calculated percent consumption} = \text{reported percent consumption.} \end{aligned}$$

Calculated percent consumption generally decreased with time, with recent studies showing a lower level of consumption (Figure 2, Table 2). This downward trend in consumption with time was found to be significant ($F=567.3$, $p<0.001$, $R^2 = 0.44$). A recent study that did not fit this trend (McLaughlin and Hay in preparation) tested a light-weight ration which provided about half the amount of food available in a regular ration pack.

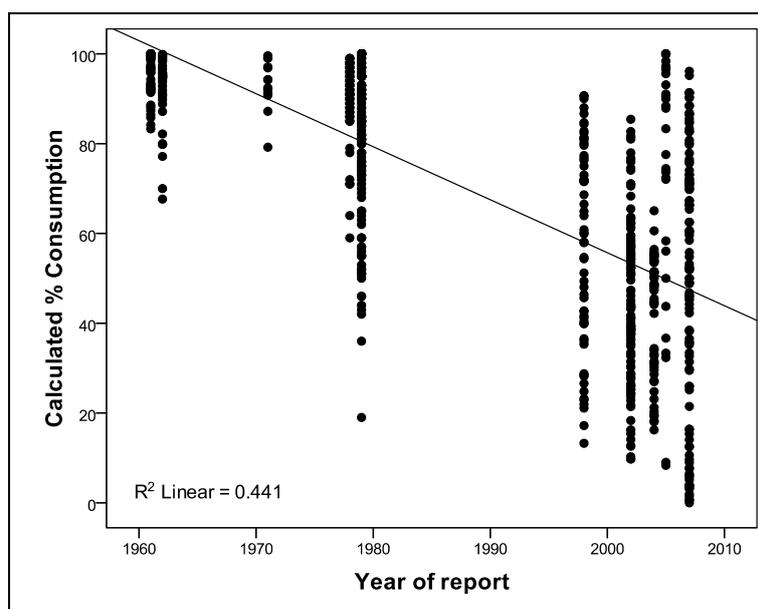


Figure 2: Calculated percentage consumption over time

Table 2: Mean calculated percent consumption for all ration pack items (12 studies)

Data Set.	(Report)	Calculated Percent Consumption			
		N	Mean	SD	95% CI
1	(Kullen <i>et al.</i> in preparation)	114	50	29.1	44-55
2	(McLaughlin and Hay in preparation)	33	76	27.2	66-85
3	(Carins and Thomson 2004)	51	41	13.6	37-45
4	(Probert, Bandara and Jayasena 2010) (2002 data)	69	36	13.7	33-39
5	(Carins 2002)	66	55	16.4	51-59
7	(Probert, Bandara and Jayasena 2010) (1998 data)	60	57	22.6	51-63
10	(Lichtenstein 1979b)	34	91	12.8	87-96
11	(Lichtenstein 1979a)	146	83	17.1	80-85
12	(Badcock and Lichtenstein 1978)	54	90	8.8	88-92
13	(Hutchinson, Gillis and Hope 1971)	15	94	5.5	91-97
14	(Hutchinson 1962)	36	92	8.4	89-94
15	(Hutchinson and McNaughton 1961)	43	95	5.0	94-97

A ceiling effect was evident in the calculated percent consumption data as it is essentially the reverse of the percent discards variable (Figure 3).

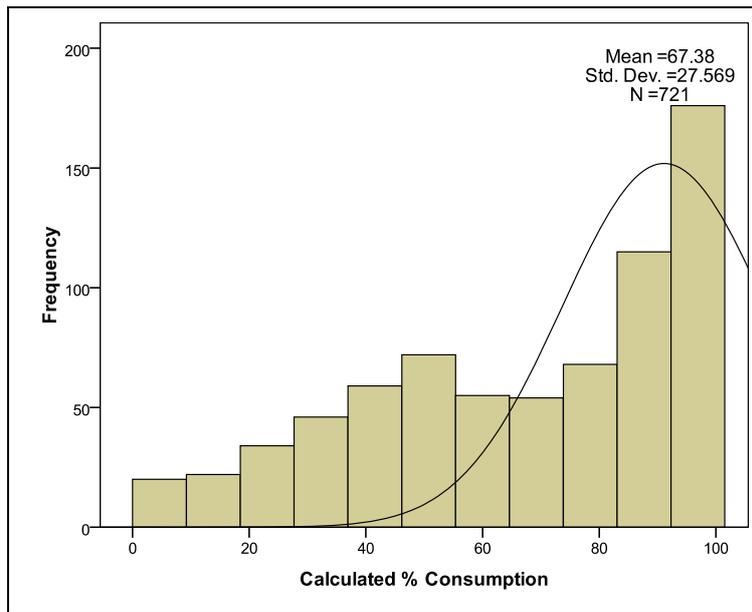


Figure 3: Mean calculated percent consumption for all ration items (12 studies)

Ratings of 'demand for more' (where 1 = not enough and 3 = too much) were examined in six studies. This variable displayed a normal distribution (Figure 4) and ratings remained reasonably consistent over time (Table 3).

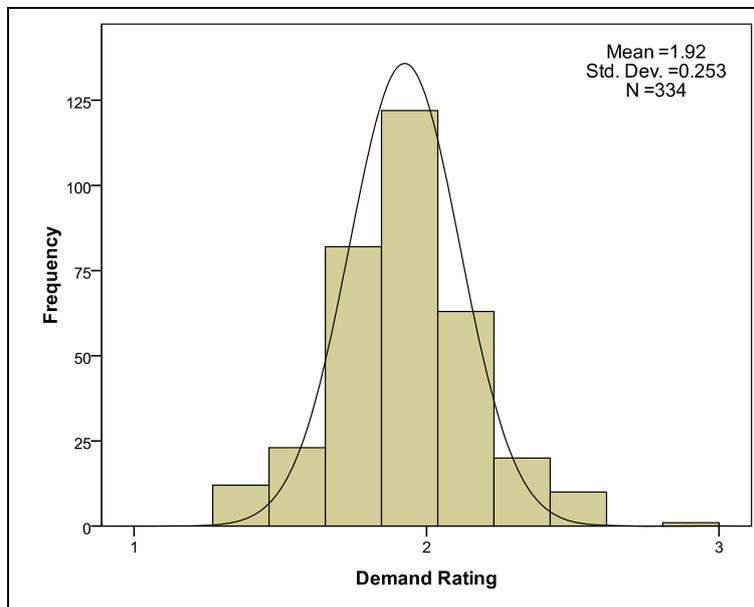


Figure 4: Mean rating of 'Demand for More' of all ration pack items (6 studies)

Table 3: Mean rating of 'demand for more' for all ration pack items across six studies

Data Set No.	(Report)	Demand for More			
		N	Mean	SD	95% CI
6	(McLaughlin and Thomson 2002)	47	1.9	0.1	1.9-2.0
8	(Stephenson, Cavanough and Driver 1998)	6	2.0	0.2	1.8-2.2
9	(Badcock 1985)	47	2.0	0.3	1.9-2.1
10	(Lichtenstein 1979b)	34	1.7	0.2	1.7-1.8
11	(Lichtenstein 1979a)	146	1.9	0.2	1.8-1.9
12	(Badcock and Lichtenstein 1978)	54	2.1	0.2	2.1-2.2

Mean acceptability ratings were examined in fifteen studies and displayed a normal distribution (Figure 5).

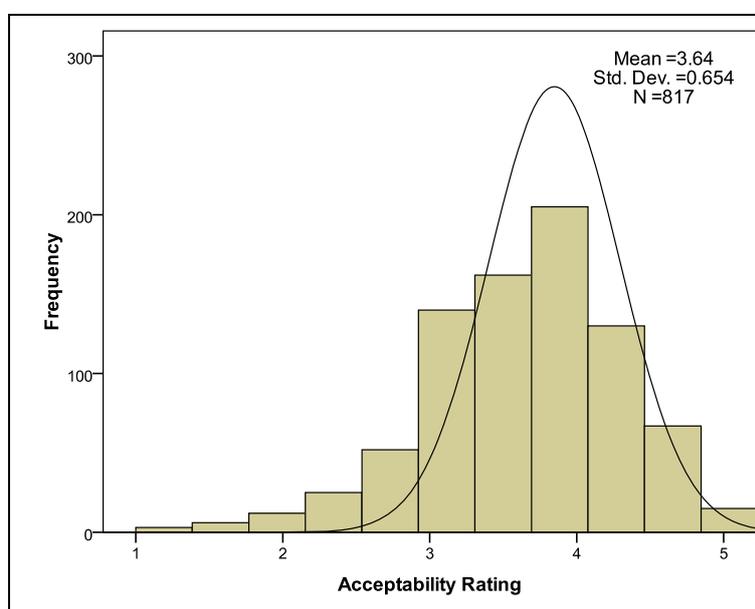


Figure 5: Mean acceptability rating for all ration pack items (15 studies)

Mean acceptability varied between studies, but did not appear to increase or decrease over time (Table 4).

Table 4: Mean acceptability ratings for all ration pack items across fifteen studies

Data Set No.	(Report)	Acceptability (Scale of 1–5)			
		N	Mean	SD	95% CI
1	(Kullen <i>et al.</i> in preparation)	114	4.2	0.5	4.1–4.3
2	(McLaughlin and Hay in preparation)	33	3.9	0.5	3.7–4.0
3	(Carins and Thomson 2004)	51	3.5	0.4	3.4–3.6
4	(Probert, Bandara and Jayasena 2010) (2002 data)	69	3.3	0.3	3.2–3.4
5	(Carins 2002)	66	3.3	0.5	3.2–3.4
6	(McLaughlin and Thomson 2002)	47	3.4	0.3	3.3–3.5
7	(Probert, Bandara and Jayasena 2010) (1998 data)	60	3.5	0.3	3.4–3.6
8	(Stephenson, Cavanough and Driver 1998)	20	2.3	0.5	2.1–2.6
9	(Badcock 1985)	47	4.0	0.4	3.8–4.1
10	(Lichtenstein 1979b)	34	3.8	0.8	3.5–4.1
11	(Lichtenstein 1979a)	146	3.8	0.7	3.7–3.9
12	(Badcock and Lichtenstein 1978)	54	3.8	0.5	3.7–4.0
13	(Hutchinson, Gillis and Hope 1971)	15	4.1	0.3	3.9–4.2
14	(Hutchinson 1962)	36	2.5	0.8	2.1–2.8
15	(Hutchinson and McNaughton 1961)	43	3.7	0.6	3.5–3.9

Acceptability was examined to see if it could be used as a predictor of consumption. Regression analysis suggested that the variation explained by acceptability was not due to chance ($F=50.5$, $p<0.001$), but the model demonstrated very poor predictability ($R^2 = 0.07$), with acceptability explaining only 7% of the variance in consumption. The ceiling effect seen with this data reduces the power of this test (Figure 6a). Data from the last ten years were examined separately to determine whether there was a relationship between these two variables in the current climate of low ration consumption. Regression analysis demonstrated a similar result of poor predictability ($F=56.3$, $p<0.001$, $R^2 = 0.14$), with acceptability explaining only 14% of the variance in consumption (Figure 6b). No ceiling effect was evident. This data shows all items were moderately acceptable through to highly acceptable, but consumption ranged anywhere from zero to 100 percent.

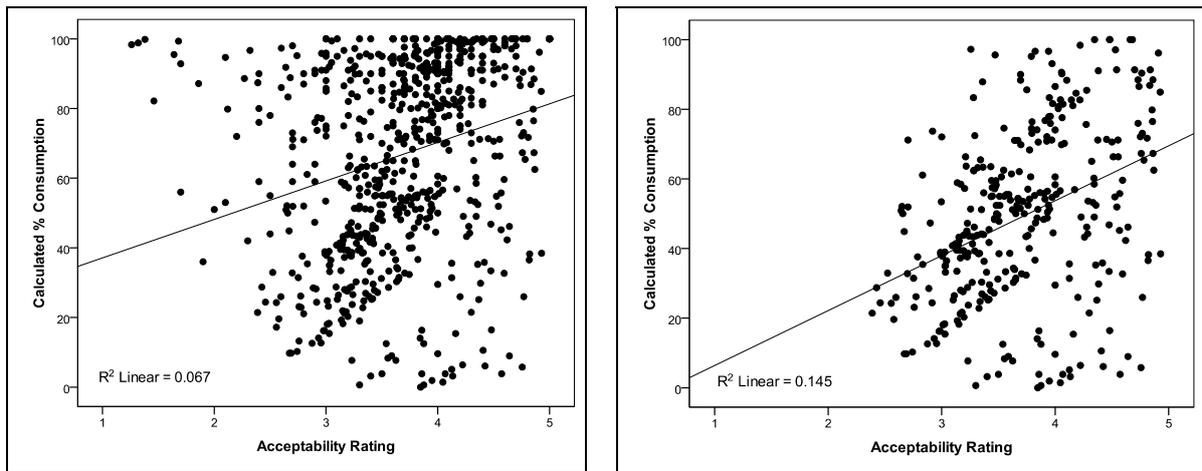


Figure 6a: Scatter plot of consumption vs. acceptability, 12 studies, 1961–2007
 Figure 6b: Scatter plot of consumption vs. acceptability, 6 studies, 2002–2008

Ration pack items were categorised into groups to determine if acceptability was an important determinant of consumption for some types of food items but not others. Four major types were examined – meal items, snacks, drinks, and ‘other items’. Twelve minor types were examined – casserole style meals with meat, casserole style meals without meat, brew items, condiments, confectionery, dried fruit, wet fruit, drinks, soup, starch, biscuits, and muesli bars.

Acceptability was found to be a reasonable predictor of consumption for some types of ration pack items. Table 5 shows the results of regression analysis for the types of food where acceptability was found to be a reasonable predictor of consumption. Visual representations of some data can be seen in Figure 7, showing the relationship between acceptability and consumption for a major type (meal items) and a minor type (biscuits).

Table 5: Regression analysis for ration pack item types, 2002-2008 data (only best predictors are shown)

Food Item Classification	Acceptability			
	N	R ²	F	p
Major types				
Meal Items	87	0.36	46.7	<0.001
Snacks	125	0.21	33.2	<0.001
Minor types				
Casserole meals with meat	48	0.32	21.7	<0.001
Starch	14	0.44	9.4	0.01
Biscuits	30	0.54	32.3	<0.001
Muesli bars	20	0.37	10.4	0.005

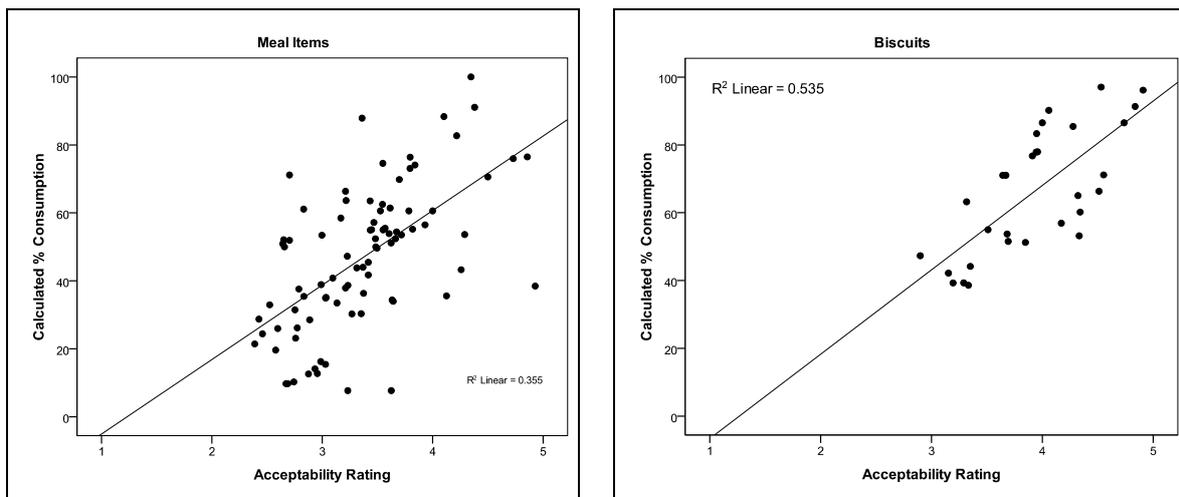


Figure 7a: Scatter plot of consumption vs. acceptability for meal items. Figure 7b: Scatter plot of consumption vs. acceptability for biscuits

4. Discussion

To quote the earliest report reviewed: “The problem is usually not so much what the individual should eat as to what he will eat!” (Langtry and Munro 1955). Therefore, when designing ration packs it is essential to consider not only what soldiers *should* be eating, but also what ration pack items they *will* eat, and the factors that determine what they will eat.

Surveys of Australian military ration packs contained findings in common with the variables of Meiselman’s Three Factor Model of influences on ration consumption (Meiselman 2010). However, many of these surveys did not examine or explain in any depth how any of these variables may have influenced consumption, and it was assumed that these collectively led to lower consumption of items in the pack.

4.1 Food

4.1.1 Portion size

It has been shown that a larger portion size will generally lead to greater consumption (Rolls, Roe and Meengs 2006). This review indicates which foods are likely to be eaten in greater quantity should more be provided. Consumption might be increased by providing larger portions of these foods, and by increasing the amount of items that are well consumed but not necessarily considered insufficient. Items that are nutrient dense – such as bread, rice, noodles or biscuits – would be prime candidates for this increase, because they offer substantial nutritional reward for a relatively small increase in availability. Larger portions (rather than additional packets of the same item), would allow access to extra food without the burden of inconvenience.

There are potential complications to take into account when considering increasing portion size, including the increase in weight and the criticality of acceptability of the items in question. There is no point offering more of something that may simply be discarded, or increasing the size and bulk of the ration for no benefit.

Although studies examined how many troops were satisfied with the portion sizes provided in the ration, or the sufficiency of food overall, when weight loss was reported (Hutchinson and McNaughton 1961, Hutchinson 1962, Younger 1966b, Booth *et al.* 2001), the majority of troops still considered they had sufficient food.

4.1.2 Food temperature

Food temperature is an important aspect to consider as consumers have expectations about the temperatures at which foods should be served. If the consumer is presented with a food that is not at the expected temperature, that item may be judged unpalatable.

Many surveys reported that the main meals are unacceptable when eaten cold. The main meals items currently provided in ration packs are notorious for presenting poorly when cold. Sauces separate, fat congeals and the flavours are weak. A main meal that may be acceptable when hot may not be acceptable if a soldier has insufficient time to heat that item. Consumption may be increased if main meals in ration packs can be formulated so that they are acceptable either hot or cold.

4.1.3 Meal components and food compatibilities

People do not normally consume food as random items throughout the day; rather food items are consumed together as meals, and a set of meals makes up the day's consumption. Foods may be combined for functional benefit (bread on which to spread jam), for flavour enhancement (addition of condiments) or for customary reasons. Similarly, meals that occur at certain times of the day have regular components.

Soldiers may have certain expectations as to the composition of each meal. When items are missing from a usual combination, then the act of consuming the remaining item(s) may seem pointless or at best less enjoyable.

The present review did not shed much light on this area – breakfast items were noted as absent, as was the lack of items to use with spreads. Some considered a snack-based ration appropriate and others preferred a meal-based ration. This is an area that warrants further investigation.

This concept also overlaps with the variable 'expectations' (a component of the factor *the individual or soldier*). It is important to consider the ways in which the two variables interact.

4.1.4 Food quality/acceptance

Meiselman (2010) considers acceptability or 'liking' of a food to be a major influence on consumption. If people like a food, then they are more likely to eat it.

Some patterns emerged during this review – some food items have been consistently ‘liked’, for example the condensed milk, while other items such as soup, rice, curry powder and butter concentrate have usually been ‘disliked.’ Given that acceptance of a food is regarded as one of the most important variables influencing consumption, it seems inappropriate that some foods which have continually been ‘disliked’ remain in the ration packs. A poorly liked product that has remained is freeze dried rice – the reasoning being that it is a good source of carbohydrate. If soldiers are not consuming the rice, then it is not a good source of carbohydrate, and it would be appropriate to conduct research into improvements to the rice (e.g. alternative varieties or different processing) or substitute another, more acceptable, carbohydrate source. Alternatively the butter concentrate present in the CR5M (group feeder), is also often disliked. However it serves a dual purpose (not only as a spread, but as an agent to grease tins for cooking and in which to fry foods). It is unlikely to be used as a spread; rather it is more likely to be used as a frying agent, and it may be appropriate to leave it in the ration for this purpose.

Highly acceptable foods do not always have high consumption rates, and in turn some items of only moderate acceptability can have quite high consumption rates. This was seen in a number of reports. Kullen *et al.* (in preparation) found that foods from core food groups with lower acceptability were consumed more than novelty foods such as chocolate that had a higher acceptability. This could be because soldiers may perceive foods such as main meals as being more important to consume as they represent the bulk of the meal and will be more filling. Another reason could be that chocolate may be well liked in normal conditions, but may not be as appealing in the heat. In some cases, lack of time or opportunity may prevent the consumption of highly acceptable items. The relationship between consumption and acceptability is discussed further in Section 4.4.

4.1.5 Food packaging and labelling

Food packaging and labelling is important so the soldier can identify the food and therefore make an informed decision about its consumption (especially when plain packaging does not provide much information). It may indicate whether the item is a product that the soldier prefers (a recognisable name), how to consume it (instructions) or it may present other information (ingredients or nutritional content).

Forbes-Ewan & Waters (1986) suggested that nutrition information should appear on the packaging of the ration item to inform soldiers of the nutritional value of their rations, to allow them to make more informed choice as to which items to discard. This is in place today in the form of a nutrition information panel. Guidance on how to interpret this information and how to use ration packs would assist greatly to ensure this information has the desired impact.

4.1.6 Food variety/monotony

Increased variety can improve consumption of foods (Rolls 1995). Based on the high number of requests in the surveys for more variety, increasing variety and decreasing monotony is a potentially effective approach to increasing consumption. This issue needs to be addressed

within menus, across menus and in the distribution system to ensure that adequate variety is built into the suite of rations, and that this level of variety reaches the soldier.

4.1.7 Remaining Variables

Food presentation can increase the immediate desire for a food when it is offered to a diner, and as a result could increase consumption. It is important that ration foods present well once opened or prepared. Findings from our review indicate that the appearance of some foods was off-putting, and although these may have been due to ingredient quality or recipe formulation rather than presentation, it demonstrates why it is crucial to have a product that is visually appealing.

Sensory-specific satiety can be considered as variety at the finest level, and is believed to influence consumption. Sensory-specific satiety occurs when the individual has reached satiation of one particular food (Rolls 1995, Stroebele and De Castro 2004). Variety within a meal or across courses assists in the reduction of sensory-specific satiety. Rations should be designed to contain a large number of items within each ration menu, rather than large portions of only a few items. This will allow transition from one flavour to another and encourage eating to continue.

Familiarity with a food is believed to be a determinant of food choice (Stephens, Pollard and Wardle 1995); foods that are authentic with respect to tradition, culture or ethnicity are likely to be recognised as familiar and therefore consumed in greater quantities. The essence of the 'food authenticity/country of origin' variable is not so much choosing foods for ration packs that suit a particular set of tastes (which is covered under the *individual/soldier* factor), but ensuring that foods are true to their origins and are recognisable as such. Australian CRP are now packed in New Zealand, and contain an increasing number of items manufactured in New Zealand. It is unclear what impact this may have on consumption either via this variable, or via the expectations of the soldier.

4.2 Soldier

Rations must be designed to suit the majority of troops, but may not be suited to each individual. Future research in this area would be useful to identify why soldiers under-consume rations.

4.2.1 Age

Results from the most recent Defence census show that 51% of permanent ADF members are less than 30 years of age (Department of Defence 2007). This young group may have different food preferences than soldiers in an older age bracket. In order to design strategies to tempt consumers, market researchers profile groups of consumers and describe their common behaviours. One set of profiles is based on age, or generations, and the majority of permanent ADF members would belong to 'Generation Y' (those born after 1977). Generation Y is described as highly brand conscious, convenience focused and having a low tolerance of imitations (Thach and Olsen 2006). Whilst still valuing 'word of mouth', Generation Y has grown up in a media-saturated world, and is accustomed to the concepts of customisation,

grab and go, convenience and ready to eat (Boss 2007). Their key nutritional focus is the potential of foods to provide them with energy and immunity (Katz 2007). Further information about food preferences for the different age groups could be used as guidance for the inclusion of age-appropriate foods in ration packs.

4.2.2 Gender

The vast majority (87%) of permanent ADF members are male (Department of Defence 2007). Further, currently only males are permitted in 'combat roles' (where there is a chance of hand-to-hand fighting), so males are by far the predominant consumers of CRP.

Males and females have different food preferences – women have a greater preference for vegetables, salads, fruits and 'healthy' food than men (Meiselman 2010). Incorporation of foods similar to these may increase consumption of the ration items by Service women, but we need to be sure that the changes do not reduce the acceptability of the ration pack for men. Further research in this area needs to address whether there is a gender difference in combat ration pack consumption or acceptability, and what the implications of these differences may be, considering the small proportion of women in the ADF.

4.2.3 Expectations

Soldiers generally have low expectations of the food items in the ration packs, the result being product ratings that move in the direction of the expectations (Cardello, Bell and Kramer 1996, Cardello 2007). Addressing the consumers' attitudes towards ration packs is not an easy task; however, Meiselman suggests incorporating familiar branded products into the ration to raise the expectations of the food, and therefore the rating (Meiselman 2010).

The way food is packaged and labelled can attract a consumer and increase the chance of consumption. This is especially true for branding, and applies in both the positive and negative direction. The general public is attracted by popular and highly visible brands, and less so to plain brand items. This could be true of military foods too – soldiers desire brand name foods and may shy away from items packed in drab green/brown packaging. Poor expectations of military foods have been observed, consumers likening it to airline or hospital food (Cardello, Bell and Kramer 1996). Whilst we saw no investigation of this in the studies we reviewed, there was evidence of 'jack rations' (rations provided by the troops themselves) being taken into the field in preference to consuming the same product types contained in the ration pack (e.g. instant noodles). We can speculate that this may be a practice that supports the notion of brand preference, or that expectations are low due to prior bad experiences with the product.

4.2.4 Religious, cultural and other dietary influences (e.g. vegetarianism) and preferences/aversions

Our review did not reveal many findings in the area of religious, cultural or other dietary influences. As our ADF population is a subset of the increasingly diverse Australian population we expect that consumption of some items would be acceptable to some individuals and not to others, and that this situation may become more common. This is a

complex problem to address. Variety within and across menus may go some way towards improving the situation, but the ideal solution – whereby the logistics system is able to deliver the preferred menu to an individual at any given time – may not be practicable in an operational situation.

4.2.5 Traits and attitudes

Traits and attitudes both influence behaviour. Traits can be defined as response tendencies in a given domain, whereas attitudes refer to the expressions of these traits, are evaluative and directed at something in particular (Ajzen 1988).

Meiselman (2010) considers five trait/attitudes to be important to ration pack design – Food Neophobia, Food Involvement, Dietary Restraint, Sensation Seeking and Variety Seeking. People who are food neophobic are reluctant to try new foods, whereas those who are food neophilic are people who like to try new foods. Food involvement determines how important food is to a person. Dietary restraint refers to a person's ability to control eating (for example when dieting). Sensation seeking and variety seeking refer to a level of need for sensation or variety (possibly via food).

Considering these traits/attitudes, it is easy to see why individual characteristics could have a large influence on ration consumption. Food neophobic soldiers may be hesitant to try novel foods or foods from foreign countries. A highly food-involved soldier will find it more important to spend time heating or preparing meals. Soldiers with a high level of dietary restraint may choose to under consume rations in an attempt to control (or reduce) their body weight. Sensation seekers and variety seekers may be frustrated by the foods contained in ration packs. All of these areas would benefit from further study.

4.2.6 Commensality

Commensality (social facilitation) is one of the variables that are believed to increase consumption markedly. Eating in a social situation results in an increased duration of the meal, an increased amount of time for eating, and an increased consumption (Meiselman 1996, Stroebele and De Castro 2004).

Social modelling is another way to increase consumption. Children tend to copy their parents' eating patterns and adolescents adopt their peer groups' eating habits. Social modelling has been observed in the military context, where soldiers exposed to positive comments about ration foods consumed more of the ration and rated the ration more positively in comparison to the control (Engell *et al.* 1990).

Eating together in a military situation may not always be possible, but it may be appropriate for commanders to consider and encourage this where it is practicable. It may also be beneficial to promote social modelling, e.g. by encouraging superior officers to set a good example of ration consumption by word and action.

4.2.7 Moods and emotions

Moods and emotions can affect food consumption, and conversely consumption of some foods can affect mood. In the military context, fear is the emotion most likely to interfere with consumption and has been shown to do so (Popper *et al.* 1989). Consumption of caffeine can alter mood, and has been investigated in the military as a means to maintain or increase cognitive and physical performance under certain conditions (Tharion, Shukitt-Hale and Lieberman 2003, McLellan, Bell and Kamimori 2004, McLellan *et al.* 2005). The consumption of food is commonly believed to have a profound effect on soldier morale.

4.2.8 Satiety

Satiety is an area of uncertainty in the military context. It is not known if soldiers eat to satiation when in the field, or if they even feel normal levels of hunger. It has been suggested that there is a need for more research in this area (Meiselman 2010).

4.3 Environment

4.3.1 Appropriateness

A major aspect of ration pack design involves choosing the individual items, their packaging and the entire ration to suit the situation in which it is intended to be used.

Some findings suggested that the packaging used was not appropriate to the environment in which it was to be used. The most appropriate rations would be robust, but not excessively heavy or bulky. Items need to strike a balance between being light (which often means dehydrated), and requiring minimal additional water (for reconstitution). Whether it is more appropriate to have three meals (including a distinct breakfast item) or a snack-based menu is unclear. The review findings suggest that packaging that is camouflaged and quiet is most appropriate, but recent investigations suggest that this may be unnecessary, or at least that the requirement for it is not clear (Carins, unpublished data).

4.3.2 Time of day/Meal patterns

There are customs that dictate what types of meals are usual and at what times of day these occur, and these may differ from person to person depending on that person's background. The meal pattern over the day (large infrequent meals versus small frequent snacking) or the type of meal served at a particular time of day (cold meal versus hot meal) may vary. Meiselman (2010) suggests that when rations are aligned with these patterns, consumption is maximised. We need further information on what is considered customary by our soldiers, and whether structuring rations based on time of day and meal patterns will enhance consumption.

4.3.3 Choice

An element of choice was introduced in two studies (Younger 1964, Booth *et al.* 2001) in the hope that soldiers would consume as much of the ration as possible. However, there were still significant discards, and ration consumption was not optimal. Rolls (1995) states that when

people have to eat foods that they have not been able to personally select, those foods tend to be less acceptable.

It is difficult to imagine how introducing an element of choice to consumption of combat rations could be practicable. Some distribution systems may allow for choice between menus at the end point, and be driven by demand, but the choice would still be quite limited compared to a free-living situation. The benefit of having greater choice may not justify the cost involved in implementing a far more flexible distribution system.

4.3.4 Location and Temperature/Weather

The field conditions experienced by soldiers are not comparable to any other eating situation, nor are they under the control of the commanding officer. The harsh conditions typically encountered are not conducive to optimal eating, or even to the supplying of many popular food items. It is therefore important to understand the conditions likely to be experienced, and to ensure that ration packs consist of foods that will still be palatable when consumed in operational environments.

Kullen *et al.* (in preparation) tested a hot weather ration that included items considered to be suitable a hot climate, using the CR1M as a comparison (control). The hot weather ration was found to be more acceptable, and was better consumed than the CR1M during a field exercise in a hot and humid environment.

A 'one-size-fits-all' ration is unlikely to be consumed well in the various conditions experienced by today's soldier. Chocolate that melts in the heat, bars that become brittle in the cold, and dried items that require the addition of water in a dry environment are of limited use under those conditions.

Further research to characterise the conditions that soldiers experience, the acceptability of food items in different conditions, and the effects of the varying conditions on the physiology of the soldier would greatly benefit ration pack design.

4.3.5 Speed of eating/eating duration

The most common reason for not consuming an item during the trial of the prototype hot weather ration previously mentioned was *No Time* (Kullen *et al.* in preparation). This is not uncommon – similar results have been documented in the US military (Popper *et al.* 1989). It is essential that ration meals are quick and easy to prepare and eat. With such limited time, consumption can be severely curbed, as soldiers eat only what they can in the short meal breaks they have. Recent investigations suggest that preference is given to other tasks over eating – when a group takes a break the commander will eat what he can in two or three minutes to enable him to attend to other tasks (Carins, unpublished data).

4.3.6 Convenience

Convenience includes the amount of time and the amount of effort required to perform the actions, in this case preparing and eating rations (Jaeger and Cardello 2007). Soldiers who are generally time poor and who may be exhausted must expend time and effort to prepare food,

consume it and clean up afterwards. Effort is also expended carrying the food into and waste out of the field.

Inconvenient aspects of CRP were found during this review, reinforcing the need for ration pack design to incorporate items that are quick and easy to use, light-weight and not excessively packaged. It has also been suggested that it is important to consider convenience more widely—beyond the human factors aspects of the packaging—to include ration distribution and post-consumption stages (Jaeger and Cardello 2007). The findings of this review support this idea; soldiers nominated inconvenient aspects of the rations concerning food preparation, but they also found rations inconvenient in terms of load carriage and waste disposal.

4.3.7 Price/value/free food

Price is a major determinant of food choice, and affects food choice via two mechanisms (Stephens, Pollard and Wardle 1995). A high price may reduce an individual's ability to consume that item (affordability) but also may enhance the desirability of that item (perception of high quality/elitism). A low price may make an item more affordable, but may also imply inferior quality.

Military rations are provided free-of-charge, so in theory consumption should be positively enhanced. But there may be a perception that the food is inferior, and that may lead to decreased consumption. In the absence of any data we cannot speculate as to how this variable is affecting consumption of ration packs. It would be interesting to consider whether the practice of taking jack rations into the field constitutes an attempt to satisfy the need to have high quality or elite items available for consumption, or rather an expression of preference for particular items.

4.4 Patterns in Consumption, Comparison with other Measures

Consumption rates of ration pack items decreased over the 50-year-period covered by this review. The reasons for this are unclear. Acceptability ratings and the desire for more individual ration pack items (demand) has changed little over the years, suggesting that there are other reasons why consumption rates have declined. Practices or duties in the field may have changed over the years, resulting in less available time to eat. Cultural norms may place less importance on taking time out to eat a proper meal than they did decades ago. Commercial items may be more readily available for use in the field as jack rations, effectively reducing dependence upon ration pack items.

Acceptability or liking is considered to be a major influence on consumption (Meiselman 2010), however most of our data did not support this. It is possible that liking in a free-living situation is a prominent determinant of consumption, but when military rations are being consumed other factors come into play.

The variation explained by acceptability was not attributable to chance, however acceptability was not a good predictor of consumption for ration pack items in general. For items that are designed to be used as required—for example condiments and drinks—this is not a surprising finding; these items may be well liked but not always consumed. But our results also

indicated that acceptability was a poor predictor of consumption for many individual item types (casserole style meals without meat, brew items, condiments, confectionery, dried fruit, wet fruit and soup). Acceptability demonstrated a more predictive power for consumption levels of casserole style meals with meat, starchy items (e.g. potato and onion powder, noodles), biscuits and muesli bars, although these models still contained large amounts of variation that was not explained.

The recent data (2002–2008) showed that even when soldiers found an item to be highly acceptable, they were no more likely to eat that item than an item they found only moderately acceptable. It suggests that there are other influences on consumption that have not been incorporated into this model. Therefore, we should continue to consider acceptability of ration pack items when designing ration packs, but we should also be searching for other factors that make major contributions to consumption rates.

5. Conclusions

The model of Meiselman (2010) and supporting literature demonstrate that ‘the food,’ ‘the soldier’ and ‘the environment’ all influence consumption. From a review of DSTO’s research in this area over 50 years, it is clear that some of Meiselman’s variables have often been examined and some never considered.

Future efforts in ration pack design would benefit significantly from the answers to three questions. What variables influence consumption? What do we already know in these areas? What variables are worthy of further investigation?

In terms of the *food* the focus of our previous research and design efforts has been concerned with optimising the sensory quality (acceptability) of ration pack items. Although an important characteristic of the food—ration design should continue to maximise acceptability—placing all our eggs in this basket may overstate the influence of this variable. Analysis of the acceptability and consumption data shows acceptability to be, at best, only a moderate predictor of consumption.

We have some indication that food temperature plays a part in ration pack consumption, as does food compatibility and variety. The provision of main meals that are appealing when eaten hot or cold is essential, as are ensuring that compatible items are present and maximising variety within and across menus. Results for the portion size variable (as determined by perceptions of sufficiency) suggest a desire for more food or larger portions, which may result in higher consumption if more food is provided.

We have not investigated the effects of food presentation, sensory-specific satiety and food authenticity. There are significant deficiencies in our knowledge of the importance and influence of these variables on consumption in the military field environment. Until further research is conducted, our efforts in this area might best be focused on providing foods that present well in the conditions likely to be experienced, combine well to reduce premature satiation and are not poor adaptations of the food types and items they represent.

The characteristics of the *soldier* have an influence on consumption but our data are limited in this area. It is important that we design ration packs to best suit the preferences and expectations of our population. We know that our population is predominantly young and male, but we do not have a clear picture of their preferences and dietary influences, and whether they are at odds with the preferences of other populations.

We suspect that soldiers' expectations of ration pack foods are low, as they are in other countries. The inclusion of foods that are identifiable as familiar branded versions may go some way to lifting expectations and, in turn, acceptability and consumption. Where practical, consideration should be given to the utilisation of social facilitation and social modelling to identify the best methods to lift consumption.

Examination of the traits and attitudes of soldiers may be enlightening and provide some insight to ration pack designers. Traits and attitudes are very individual in nature, so investigations in this area would serve to identify commonly occurring traits/attitudes and how ration design might exploit these to encourage consumption.

The influence of the *environment* cannot be ignored, especially when it differs greatly from the normal eating situations experienced by the general population and military personnel when not on operations. We have some data indicating when ration packs and items have not been appropriate; investigation of what would be considered appropriate is warranted. Already we know that rations should be robust, reasonably light and not require large volumes of water for preparation. Because convenience is likely to be a major determinant of ration pack consumption in all situations, even more so in high tempo training and operations, meals or snacks should be quick and easy to prepare and eat. Waste should be kept to a minimum. We need to resolve whether camouflage packaging is essential. We also need to determine the preferences for snack-based rations versus meal-based rations and which are better consumed.

Underconsumption of ration packs is a common problem. Food is fuel for the body and a soldier's body represents an important piece of physical and cognitive capability essential to the performance of his role. It is imperative that soldiers fuel their bodies to perform at their best. The findings of this review provide guidance for future ration pack design. Investigation of the other variables described in the Three Factor Model will provide further guidance.

6. Recommendations

It is recommended that:

1. Portion size

- Larger portion sizes should be considered for popular and nutritionally dense items in the ration packs. This would need to be considered within the context of a balanced nutritional menu. The optimal portion size would need to be determined.
- The larger portion size should be in the same packaging (increase that package size) to give the soldier access to more food without the inconvenience of dealing with more packages.

2. Food temperature

- Main meals should be palatable both heated and unheated.
- All ration pack food components should be suitable – including their palatability – for consumption in the climates and/or other environments in which the ration pack is intended to be used.

3. Food compatibilities

- Ration pack design should consider food compatibilities, to ensure that products that are customarily served together are present within a menu, so that consumption of a product is not reduced for want of a functional or flavour enhancing partner.

4. Acceptability

- Further research should be conducted into reformulations or substitutes for the items which have continually been reported as unacceptable.
- The quality/acceptability/likeability of the foods in Australian ration packs should be monitored regularly to determine which products are not acceptable to soldiers and the reasons for their unacceptability.
- Efforts to identify new products for ration packs and to assess their acceptability should continue to be supported.

5. Variety

- More variety should be incorporated into the ration packs. This could be in the form of more main meal options, as well as more flavours/varieties of snack foods.

- The ration packing system should be modified to ensure that a mixture of menus is always available to soldiers.

6. The Soldier/Individual

- Future research should be directed to determining the characteristics and preferences of Australian soldiers for the purpose of incorporating trends into ration pack design.
- Consideration should be given to including familiar branded products in ration packs to raise expectations of the standard of ration pack food.
- Social influences should be further investigated including considering the benefits of social facilitation and social modelling, amongst other social and behavioural psychology frameworks.
- As part of their training, soldiers should be educated about the nutritional composition of the ration packs and how the ration is designed to be eaten.

7. Appropriateness

- Ration packs should be designed to be robust, reasonably light and strike a balance between being lightweight and requiring minimal accompanying water for preparation.
- The requirement for camouflage packaging should be clarified.
- Other determinants of appropriateness should be investigated.

8. Meal patterns

- The preference for snack-based or meal-based rations should be determined.
- The consumption of snack-based or meal-based rations should be assessed.

9. Convenience

- Convenience, especially the amount of time and effort required to prepare and eat, should be an important selection criterion when considering food products for inclusion in ration packs.
- The ration pack as a whole should be assessed with a view to maximising 'convenience' and minimising waste.

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Appendix A: List of Reports and Brief Description

The reports are listed here, and in the following tables in reverse chronological order.

1. Kullen, C. J., et al. (in preparation) Field Evaluation of a Prototype Hot Weather Ration.

This trial tested a prototype Hot Weather Ration (HWR) against the current CR1M. The HWR was a snack-based ration consisting of main meals (some menus of which did not require heating), muesli/energy bars, beef jerky, savoury snacks (biscuits/nuts) dried fruit, protein drinks, tuna, sports drinks, protein drinks, cheese, chocolate sweetened condensed milk, condiments, tea, coffee and sugar; whereas the CR1M contained main meals (retort pouches), biscuits, muesli bars, fruit grains, cheese, canned fruit, noodles, potato and onion powder, fruit drink powders, soup powders, chocolate, candies, sweetened condensed milk, condiments, tea, coffee and sugar. The trial took place during a jungle warfare training course in far north Queensland, in 2007. A total of 65 soldiers participated in the trial.

2. McLaughlin, T. N. and Hay, T. K. C. (in preparation) Light Weight Ration.

This trial assessed a prototype Light Weight Ration (LWR). The LWR was an eat-on-the-move, nutrient-dense ration containing COTS products (energy bars, energy gels, trail mix, candies, tuna/chicken/chilli con carne, condiments, tea, coffee and sugar) with minimal packaging. It was designed for short periods of use, for example during initial insertions. The trial took place during EX Talisman Saber in June 2007, involving 70 participants from 3RAR engaged in an airborne insertion and subsequent operational activities for 72 hours.

3. Probert, B., Bandara, A. and Jayasena, V. (2010) Australian Defence Force Requirements for a Group-Feeding Ration Pack.

This report draws together the results of three surveys conducted and previously reported in brief. One survey was done in 1998, and the other two in 2003. The surveys tested the acceptability and suitability of the Combat Ration 5 Man (CR5M). The CR5M consists of main meals, soup, vegetables, fruit pudding, muesli bars, cheese, chocolate, candies, drink powders, condiments, tea, coffee and sugar. The surveys were conducted during field exercises all over Australia. A total of 137 participated in the 1998 survey; and 140 and 71 soldiers took part in the two 2003 surveys.

4. Carins, J. E. and Thomson, G. F. (2004) PR1M Acceptability Survey (Internal Report to Senior Inspector Foodstuffs, ADF Catering Group).

This survey examined the acceptability of the Patrol Ration One Man (PR1M). The Ration consisted of freeze dried main meals, biscuits, candy, potato and onion powder, rice, fruit grains, muesli bars, noodles, beverage powders, condiments, tea, coffee and sugar. Surveys were completed by two groups during exercises conducted at Combat Training Centre. A total of 129 soldiers participated.

5. Carins, J. E. (2002) The Acceptability of the Combat Ration One Man (CR1M) Ration Pack in the Field: A Survey.

This survey examined the acceptability of the CR1M. The ration consisted of main meals (retort pouches), biscuits, muesli bars, fruit grains, cheese, canned fruit, rice, noodles, potato and onion powder, fruit drink powders, soup powders, chocolate, candies, sweetened condensed milk, condiments,

tea, coffee and sugar. Surveys were completed by groups working in the field. Two reserve groups were surveyed during exercise at Singleton and Puckapunyal. Surveys were also collected from regular army units at Darwin, Holsworthy, Brisbane and Townsville. A total of 456 soldiers participated.

6. McLaughlin, T. N. and Thomson, G. F. (2002) Patrol Ration One Man Trial Pack Acceptability Survey.

This survey examined user acceptability of a trial Patrol Ration One Man. The ration consisted of main meals (one retort pouch and one freeze dried meal) biscuits, muesli bars, fruit grains, fruit drink powders, soup powders, chocolate, candies, sweetened condensed milk, condiments, tea, coffee and sugar. Surveys were distributed to 2FSB, 3RAR, 1CDO, REGT and 4RAR (CDO). A total of 307 surveys were returned.

7. Forbes-Ewan, C. H. (2001) Acceptability and Service Suitability of the Combat Ration One Man during Operation Warden.

This study was a retrospective survey about the acceptability and service suitability of the CR1M during Operation Warden. The ration consisted of main meals (retort pouches), biscuits, muesli bars, fruit grains, cheese, canned fruit, rice, noodles, potato and onion powder, fruit drink powders, soup powders, chocolate, candies, sweetened condensed milk, condiments, tea, coffee and sugar. A total of 192 surveys were completed by soldiers from 3 RAR, 2RAR and 2 AFDS.

8. Booth, C. K., et al. (2001) The Effect of Consumption of Australian Combat Rations on Military Personnel after a Medium-Term Field Exercise.

This trial examined the effect of ration pack feeding on military performance in a tropical environment. Soldiers were feed three diets – fresh food, a full ration pack equivalent and a half ration equivalent. Items were selected by soldiers from existing combat ration pack items (freeze dried and retort pouch meals, rice, noodles, potato and onion powder, soup powder, cheese, fruit grains, canned fruit, biscuits, muesli bars, fruit drink powders, condiments, tea, coffee and sugar. The trail lasted for 12 days, and 33 soldiers participated.

9. Stephenson, T. N., Cavanough, P. J. and Driver, G. E. (1998) Acceptability of the Patrol Ration One Man.

This survey tested the acceptability and service suitability of the PR1M. The PR1M consisted of main meals, rice, potato and onion powder, noodles, muesli bars, biscuits, confectionery, fruit drink powders, condiments, tea, coffee and sugar. The surveys were mostly filled out during field exercises which included counter terrorist activities. A total of 126 surveys were completed.

10. Driver, G. E., et al. (1996) Trial and Evaluation of Australian Re-designed Ration Packs - Lightweight Individual Meal Ration Pack (IMCR) and Combat Ration Five Man (CR5M).

For this survey, sample ration packs were assembled to be presented to soldiers in barracks for tasting and assessment. New technologies such as freeze-dried meals and pouched meals, the suitability of the IMCR and CR5M and food preferences were being assessed. The IMCR consisted of freeze dried main meals, biscuits, cheese, fruit drink powders, sweets, chocolate, sweetened condensed milk, chocolate drink powder, condiments, tea, coffee and sugar. The CR5M consisted of pouched main meals, soup powder, vegetables, biscuits, chocolate, canned fruit, fruit cake, muesli bars, cheese, spreads,

condiments, tea, coffee and sugar. The prototypes were examined and tasted and discussed in small groups then the questionnaire was administered. A total of 157 surveys were analysed for the IMCR and 161 for the CR5M.

11. Forbes-Ewan, C. H., Morrissey, B. L. L. and Waters, D. R. (1988) Field Evaluation of Australian Ration Packs. Acceptability of the Individual Meal Combat Ration.

This survey was tested the field acceptability of the IMCR. The one meal ration consisted of a main meal item, biscuits, fruit drink powder, sweets, condiments, tea, coffee and sugar. The survey was administered during a number of exercises at a variety of locations. A total of 329 questionnaires were completed.

12. Forbes-Ewan, C. H. and Waters, D. R. (1987) Field Evaluation of Australian Ration Packs. Revision of Combat Ration Ten Man.

This survey examined the field acceptability and service suitability of CR10M. This group feeding ration consisted of main meals, vegetables, fruit pudding or canned fruit, condiments, tea, coffee and sugar. Bread, biscuits or rice were issued separately as a supplement. Two exercises were used for the trial which were at Woomera (where soldiers worked hard in extreme hot temperatures) and Shoalwater Bay (where the climate was mild and the workload less strenuous). A total of 278 questionnaires were completed.

13. Forbes-Ewan, C. H. and Waters, D. R. (1986) Field Evaluation of Australian Ration Packs. Revision of Combat Ration One Man.

This survey evaluated the field acceptability and service suitability of CR1M. The ration consisted of main meals, rice, potato and onion powder, canned fruit, soup powder, cereal block, survival biscuits, cheese, chocolate, condiments, tea, coffee and sugar. The survey was conducted during three field trials which were representative of an array of climatic conditions, terrains and workloads. In total 641 surveys were completed.

14. Badcock, W. E. (1985) Field Evaluation of Australian Ration Packs Combat Ration Ten Man.

In this report, the acceptability and adequacy of CR10M was assessed. The ration consisted of main meals, vegetables, pudding, canned fruit, jam, butter concentrate, sweetened condensed milk, condiments, tea, coffee and sugar with a cereal supplement of bread, biscuits or rice. The surveys were completed during normal training exercises. There were 610 subjects.

15. Badcock, W. E. and Lichtenstein, D. J. (1981) Field Evaluation of Australian Ration Packs. Emergency Flying Ration.

This trial tested the acceptability of the Emergency Flying Ration during the combat survival course conducted by the RAAF. The ration consisted of beef blocks, soup cubes, biscuits, cheese, cereal block, butterscotch, candy, chocolate, tea, coffee, milk powder and sugar. A total of 531 participants were surveyed.

16. Lichtenstein, D. J. (1979b) Field Evaluation of Australian Ration Packs. Combat Ration (One Man) 1976/77. Exercise Top Point.

This field trial was testing the user acceptability, adequacy and service suitability of the CR1M. The purpose was to confirm earlier results 1978 and early 1979. The trial ran for 4 days, with 43 participants from 2/4 RAR.

17. Lichtenstein, D. J. (1979a) Field Evaluation of Australian Ration Packs. Combat Ration (One Man) 1976/77.

This trial tested a prototype CR1M (RPP 76/77) designed to address issues found during the 1978 evaluation of the CR1M (RPP 75/76). In the prototype CR1M the fudge had been removed, as well as one packet of survival biscuits. Canned fruits were reintroduced and butter concentrate and potato and onion powder were added. The trial was conducted with platoons from 6 RAR and 8/9 RAR over a five day period. There were 42 participants in total.

18. Lichtenstein, D. J. and Venkata-Raman, S. (1979) Patrol Ration (One Man), New Prototype Trialled at Exercise Emu 2.

This trial tested a prototype PR1M designed to address issues found during the 1978 evaluation of the PR1M. The three least popular main meals had been replaced with new recipes, as well as the rice and candy creamy fudge being replaced. Twenty-four troops from 3 SAS Sqn were used as subjects during a patrol lasting six days.

19. Badcock, W. E. and Lichtenstein, D. J. (1978) Field Evaluation of Australian Ration Packs.

This trial tested the consumer acceptability and service suitability of PR1M and CR1M. The CR1M contained main meals, rice, cereal block, biscuits, cheese, chocolate, soup powders, sweets, drink powders, condiments, tea, coffee and sugar. The PR1M contained freeze dried main meals, biscuits, cheese sticks, rice, fudge, fruit drink powders, condiments, tea, coffee and sugar. Data was collected from fourteen different exercises conducted all over Australia and a total of 352 troops were surveyed.

20. Hutchinson, R. C., Gillis, R. and Hope, G. (1971) Field trial of prototype Patrol Ration (PNG).

This trial tested a prototype patrol ration for Papua New Guinea. The ration consisted of freeze dried meat, rice, biscuits, chocolate, condiments, tea, coffee and sugar. The trial took place during a four day patrol through jungle near Port Moresby. A total of 100 Pacific Islands Regiment soldiers and 17 Australian soldiers participated in the trial.

21. Hutchinson, R. C., Reck, L. A. and McLelland, J. A. (1970) Field trial of additional varieties of the Combat Ration (One Man) Lightweight.

The aim of this trial was to test consumer acceptability of four new varieties of one man ration packs. The ration consisted of four new varieties of main meals, plus rice, biscuits, sweets, candies, condiments, tea, coffee and sugar. The trial took place during an exercise at Shoalwater bay and lasted for eight days. There were 104 participants from 3RAR.

22. Dowman, I. D., McLelland, J. A. and Reck, L. A. (1970) Field trial of the third prototype Combat Ration (10 Man) Lightweight.

The purpose of this trial was to test consumer acceptability and service suitability of the third prototype CR10M Lightweight. The ration consisted of egg blocks, main meal blocks, dessert blocks, porridge blocks, potato powder blocks, bread blocks (all dehydrated), soup powder, rice, biscuits, fruit drink powder, sweets, condiments, tea, coffee and sugar. The ration was tested during a training exercise in North Queensland. A total of 256 soldiers from 12 Field Regiment were divided into three groups each participating in different activities. An independent report was also received from a Light Aid Detachment that was also using the ration.

23. James, D. G. and Row, B. E. (1970) Field trial of the second prototype Combat Ration (10 Man) Lightweight.

This trial tested consumer acceptability and service suitability of the second prototype CR10M Lightweight. The ration consisted of egg blocks, main meal blocks, dessert blocks, porridge blocks, potato powder blocks, bread blocks (all dehydrated), rice, biscuits, fruit drink powder, sweets, condiments, tea, coffee and sugar. There were 203 troops who participated in the trial which took place on Cape Barren Island.

24. Younger, C. F. A., Spencer, G. P. and Dowman, I. D. (1969) Field trial of the prototype Combat Ration (10 Man) Lightweight.

In this trial the consumer acceptability and service suitability of the prototype CR10M Lightweight was tested. The ration consisted of egg blocks, main meal blocks, dessert blocks, porridge blocks, potato powder blocks, bread blocks (all dehydrated), rice, biscuits, fruit drink powder, condiments, tea, coffee and sugar. The trial took place during an exercise held near Townsville in Queensland, after which 116 questionnaires from soldiers were analysed.

25. Poole, B. T. (1968) Field trials of varieties "D" and "E" of the Combat Ration (One Man) Lightweight.

The aim of this trial was to test the consumer acceptability and service suitability of two new varieties of the CR1M Lightweight under field conditions, which included comparison of dehydrated meals with freeze dried meals. The rations consisted of main meals (both dehydrated and freeze dried), biscuits, a sweet bar, tea, coffee, sugar and condiments. The trial took place in Papua New Guinea and conditions were hot and humid. A total of 67 surveys were completed.

26. Younger, C. F. A. (1967b) Field trials of third prototype combat ration (one man) lightweight.

This purpose of this trial was to test consumer acceptability, nutritional adequacy and service suitability of the third prototype Combat Ration One Man Lightweight. The ration consisted of main meals, ration biscuits, cheese, sweet biscuits, chocolate discs, instant cream, coffee and condiments. The trial took place in a hot, humid region of South East Asia, involving 64 soldiers.

27. Younger, C. F. A. (1967a) Field trials of modified patrol ration for Pacific Islands Regiment. Supplementary Report.

This trial was testing acceptability of the modified Patrol Ration for the Pacific Island Regiment, with Special Air Services personnel. The ration consisted of main meals, vegetable blocks, fruit candies, rice, biscuits, chocolate, curry powder, milk, sugar, tea and coffee. It was tested during patrols of 14 day duration in Papua New Guinea. Surveys were given to the SAS troops to determine the acceptability, adequacy and service suitability of the ration.

28. Younger, A. E. (1966b) Field trials of modified patrol ration for Pacific Islands Regiment.

The aim of the trial was to determine consumer acceptability and service suitability of the modified patrol ration, with the Pacific Island Regiment. The ration consisted of main meals, vegetable blocks, fruit candies, rice, biscuits, chocolate, curry powder, milk, sugar, tea and coffee. The rations were tested over fourteen days during patrols in Northern New Guinea.

29. Younger, A. E. (1966a) Analysis of rations taken by Australian soldiers on patrol in Borneo.

This was a small pilot trial, investigating the weight and calorific value of ration items taken on patrol by soldiers. To do this they recorded the actual weights and calorific values of the ration items taken on patrol after soldiers may have discarded items (a process known as 'stripping'). Details of 64 rations were analysed.

30. Rayner, H. J. (~1966) Combat ration (one man) experimental user acceptability trial.

The purpose of this trial was to establish whether an experimental CR1M was more or less acceptable than the standard CR1M. Each menu of the experimental CR1M contained two canned meals, cereal block, biscuits, rice, curry/onion powder, chocolate, candy, sweetened condensed milk, tea, coffee, powdered beverage, sugar and salt. The six day trial was conducted at Jungle Training Centre in Canungra, QLD. There were 252 troops involved with the trial.

31. Smith, S. W. C. (1965) Field trials of prototype patrol ration.

This trial tested the acceptability, consumption, satiety value, nutritional adequacy and ease of portability of four varieties of a prototype patrol ration. Another aim was to choose one of these varieties that would be suitable for use by both Australians and Pacific Islanders. The ration consisted of canned meat or main meals, dehydrated beef bars, dehydrated vegetables, rice, biscuits, milk, tea, coffee and sugar. The trial was conducted over 14 days, with 33 men.

32. Smith, S. W. C. (1964) Training ration pack (two man) report on consumer acceptance questionnaires.

This report details the results of analysis of questionnaires distributed to user units in all commands to assess the general acceptability of the Training Ration Pack Two Man. The ration consisted of canned main meals, vegetables, rice, pudding, dried fruit, spreads, juice, condensed milk, tea, coffee and sugar. A total of 359 surveys were returned.

33. Younger, A. E. (1964) Development trial on a special purpose ration pack.

The aim of this trial was to determine the acceptability of a special purpose, lower calorie ration pack under hot, dry conditions. Soldiers were allowed to choose the items from a list of items to make up the ration, as long as the total energy was near to 2,800 calories. They were also permitted to make exchanges for items of similar calorific value. As the usual energy content of a ration was 3,500 calories, physical deterioration of the troops was closely monitored to determine if normal activities could be conducted on the lower calorie ration. The ration was comprised of canned main meals, mutton and beef bars, dehydrated vegetables, fruit slice, sweet biscuits, ration biscuits, soup powder, rice, cheese, chocolate, fruit candies, milk, tea, coffee and sugar. There were 79 men who completed the trial.

34. Hutchinson, R. C. (1962) Field trials of second prototype light-weight (one man) ration pack.

In this trial, the acceptability, nutritional adequacy and service suitability of the revised light weight combat ration was tested. The rations consisted of canned spaghetti or noodles, cheese, biscuits, mutton and beef bars, rice, chocolate discs, milk powder, onion and curry powders, spreads, tea, coffee and sugar. Members of 2RAR participated in the trial while engaged in border security operations on the border of Northern Malaya and Thailand. Surveys were completed by 154 troops.

35. Hutchinson, R. C. and McNaughton, J. W. (1961) Field trials of prototype combat ration light weight, one man.

This trial determined the acceptability, nutritional adequacy and service suitability of a range of prototype lightweight Combat rations (One Man). Each of the prototype menus contained biscuits, cereal block, chocolate, fruit candies, instant desserts, cheese, instant milk, sweetened condensed milk, canned meat or meals, dehydrated vegetables, tomato sauce, sweet spreads, tea, coffee, sugar and salt. There were two different groups, of about eighty men each, testing the rations; one in Holsworthy, NSW and the second in Puckapunyal, Victoria. The trial ran for nine days.

36. Langtry, J. O. and Munro, R. D. (1955) Field trials of 24 hr Ration Pack (One Man) – Experimental pack No. 1.

This report details the results of field trials of a new 'special ration', the first Australian individual ration pack. The 24-hour Ration Pack (One Man) consisted of dried or canned main meals, cheese, biscuits, fruit and cereal blocks, chocolate, fruit tablets, barley sugar, sweetened condensed milk, tea and sugar. Troop trials were conducted in northern Australia and New Guinea to assess this ration.

Appendix B: Consumption of Ration Packs during Trials

Report	Ration concerned	Measurement of Consumption	Findings	Conclusion
1. (Kullen <i>et al.</i> in preparation)	Prototype Hot Weather Ration (HWR) was compared with Combat Ration One Man (CR1M)	Consumption of each item measured using bar-coding technology. Items were registered when issued to soldiers, and counted as “used”, “partially used” and “not used” on return.	Highly consumed items from both rations were snacks (biscuits, bars, jerky, confectionery, nuts, tuna). Poorly consumed items were condiments, beverage powders, soup and potato and onion powder.	The HWR was rated as a success as more of the snack-based HWR was consumed (61% of available energy) than the CR1M (45% of available energy).
2. (McLaughlin and Hay in preparation)	Prototype Light Weight Ration (LWR)	Consumption of each item measured by counting discards at the end of the three day period.	Consumption was high, with highly consumed items being jerky, candies, tuna, bars, trail mix. The least consumed items were tea, coffee, sports drink powders, and gels.	N/A
3. (Probert, Bandara and Jayasena 2010)	Combat Ration Five Man (CR5M)	Consumption was not directly observed, but measured for each item via a survey using a 3 point scale of “none”, “some” or “all” consumed.	Highly consumed items were main meals, snacks, cheese and chocolate. Poorly consumed items were soup, drinks, condiments, and some muesli bars.	It was concluded that the ration is not fully meeting the needs of the ADF, and that the CR1M and the PR1M could easily substitute for the CR5M.
4. (Carins and Thomson 2004)	Patrol Ration One Man (PR1M)	Consumption was not directly observed, but measured for each item via a survey using a 3 point scale of “none”, “some” or “all” consumed.	Highly consumed items were main meals, biscuits and fruit grains. Poorly consumed items were condiments, potato and onion powder, rice and drink powders.	It was concluded there was strong support for the pack from those using it in the field. Some improvements were recommended.
5. (Carins 2002)	Combat Ration One Man (CR1M)	Consumption was not directly observed, but measured for each item via a survey using a 3 point scale of “none”, “some” or “all” consumed. Soldiers were also asked to list items they did not use.	Items well consumed were main meals, biscuits, muesli bars, canned fruit, cheese and confectionery. Poorly consumed items were the soups, freeze dried rice, potato and onion powder, sports drinks and condiments.	A number of items were rated as unacceptable, and changes were recommended to improve the ration.
6. (McLaughlin and Thomson 2002)	Patrol Ration One Man (PR1M) Trial Pack	Consumption was not examined, but demand was measured on a 3 point scale of “not enough” to “too much”. Soldiers were also asked to list items they did not use.	The majority of responses fell into the “enough” category, but some items (some main meals, fruit grains, jam sandwich biscuit, brew gear, toilet paper) had high responses in the “not enough” category. For unused items, 59% discarded at least one item. Commonly discarded items were soups, sports drinks and condiments.	Concluded the trial pack was favourably received.

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Report	Ration concerned	Measurement of Consumption	Findings	Conclusion
7. (Forbes-Ewan 2001)	Combat Ration One Man (CR1M)	Consumption was not examined, but soldiers were asked to list items they discarded or exchanged.	A total of 98% of soldiers stated that they discarded items. Foods commonly discarded were muesli bars, baked beans, chocolate, candy and rice.	A number of changes were recommended including investigation of more acceptable high carbohydrate foods and the development of a light weight ration.
8. (Booth <i>et al.</i> 2001)	Full Ration Equivalent and Half Ration Equivalent	Measured food consumption and discards of ration packs to determine energy intake during the trial. Consumption of individual items not reported, just overall energy intake.	Rations were underconsumed, soldiers in the full ration group eating ~60% of the energy provided by the ration and the half ration group eating ~90% of the energy provided by the ration. Both consumed less than their estimated daily total energy expenditure.	Concluded that there were measurable negative changes in nutritional, physiological and psychological status with both the full and half ration groups.
9. (Stephenson, Cavanough and Driver 1998)	Patrol Ration One Man (PR1M)	Consumption was not examined, but demand was measured on a 3 point scale of "not enough" to "too much". Also asked soldiers to list items they discarded or exchanged.	Most items were considered to be provided in sufficient quantity. For discards and exchanges, 68% of soldiers stated they discarded at least one item, 36% exchanged at least one item. Commonly discarded items were condiments, potato and onion powder, rice, beverage powders and sweets.	Concluded that changes needed to be made to the PRIM to reduce the culling of items from the ration.
10.(Driver <i>et al.</i> 1996)	Individual Meal Combat Ration (IMCR) and Combat Ration Five Man (CR5M)	Consumption or discards were not examined.	N/A	Both rations were found to be acceptable in the group sessions and recommended for testing in the field.
11.(Forbes-Ewan, Morrissey and Waters 1988)	Individual Meal Combat Ration (IMCR)	Consumption rates were not examined.	The questionnaire asked soldiers to list items they discarded. At least one food item was discarded by 36% of soldiers, the most common items being non-food items or brew gear.	The conclusion was the IMCR was well received in the field, and minor modifications would make it even more acceptable.
12.(Forbes-Ewan and Waters 1987)	Combat Ration Ten Man (CR10M)	Consumption rates were not examined.	The questionnaire asked soldiers to nominate the frequency of consumption of only the desserts. At least one food item was discarded by 83% of soldiers, the most common items being butter concentrate, butterscotch, and cereal block.	The conclusion was that the ration was basically sound, but more variety of food and drinks and flavouring agents was needed.

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Report	Ration concerned	Measurement of Consumption	Findings	Conclusion
13.(Forbes-Ewan and Waters 1986)	Combat Ration One Man (CR1M)	Consumption rates were not examined.	N/A	The conclusions were that the ration was overdue for an extensive overhaul, and a long list of recommendations for this was given.
14.(Badcock 1985)	Combat Ration Ten Man (CR10M)	Consumption was not examined, but demand was measured on a 3 point scale of "not enough" to "discarded it".	Red kidney beans, biscuits and chopped pork and cereal had highest discard rates. Items with low discard rates include peaches, carrots, pea and ham soup powder, cut potato, fruit salad, and peas.	The ration was considered adequate for its purpose, but could be improved.
15.(Badcock and Lichtenstein 1981)	Emergency Flying Ration	Consumption and discard rates were not examined.	N/A	The ration pack was deemed satisfactory, and a few recommendations were made for improvement.
16.(Lichtenstein 1979b)	Combat Ration One Man (CR1M)	Consumption was measured by collecting discards at the beginning during and end of the trial.	Commonly discarded items included fruit drink powders, butterscotch and butter concentrate. Peaches, two fruits and cheese had zero discard rates.	These results confirmed that the ration was considered to be an improvement over the previous version.
17.(Lichtenstein 1979a)	Combat Ration One Man (CR1M)	Consumption was measured by collecting discards at the beginning during and end of the trial.	Common discards were instant rice, cereal block, survival biscuits, curry powder, soup powders, fruit drink powders, candy creamy fudge and salt. Items with a low discard rate included main meals, canned fruit and jam.	The ration was considered to be an improvement over the previous version, with further field trials recommended to confirm these results.
18.(Lichtenstein and Venkata-Raman 1979)	Patrol Ration One Man (PR1M)	Consumption was not measured.	Soldiers were able to suggest items that should be deleted. Candy creamy fudge was nominated for deletion by 75% and 42% wanted sweet and sour pork deleted from the current PR1M. The prototype PR1M did not contain these two items and there were also fewer requests for deletion of items.	The prototype was considered to be an improvement on the current PR1M.

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Report	Ration concerned	Measurement of Consumption	Findings	Conclusion
19.(Badcock and Lichtenstein 1978)	Patrol Ration One Man (PR1M) and Combat Ration One Man (CR1M)	Consumption was not directly measured, but discards for each item were analysed by questionnaire.	Discards for PR1M: 22% discarded candy creamy fudge, 13% discarded instant milk powder, 9% discarded shortbread biscuits, and 9% discarded orange drink powder. Items with low discard rates include beef and beans, savoury steak fingers and beef and onion. Discards for CR1M: 41% discarded candy creamy fudge, 36% discarded cereal block, 29% discarded the lime fruit juice powder, 29% discarded the lemon fruit juice powder and 28% discarded the orange fruit juice powder. Items with low discard rates include sweetened condensed milk, cheese and beef and vegetables.	The PR1M was considered to be of doubtful utility in the drier parts of Australia, and major recommendations were made for improvement. The CR1M was considered to be satisfactory for the task for which it was designed and only minor improvements were suggested.
20.(Hutchinson, Gillis and Hope 1971)	Patrol Ration (PNG)	Consumption was assessed by measuring unconsumed food at the end of each day.	The average wastage each day was 5.6% of the ration (~180 calorie or 760KJ). Butter concentrate was most commonly discarded (20.8% wasted).	The ration was considered to be acceptable with minor improvements.
21.(Hutchinson, Reck and McLelland 1970)	Combat Ration One Man (CR1M) Light weight	Consumption rates were determined by examining unconsumed food which was collected by helicopter usually each day.	The most commonly returned foods were "Max Mints" (39% returned), fruit candies (37% returned), instant tea (18% returned) and express rice (17% returned).	The ration was rated as having a high overall acceptability.
22.(Dowman, McLelland and Reck 1970)	Combat Ration Ten Man (CR10M) Light weight	Consumption rates not examined.	The ration was rated as not suitable for field or moving groups, but successful in a base area. The need for it in a base area was questioned due to the ability to supply fresh and canned food.	The ration was rated as not suitable for field or moving groups, but successful in a base area. The need for it in a base area was questioned due to the ability to supply fresh and canned food.
23.(James and Row 1970)	Combat Ration Ten Man (CR10M) Light weight	Consumption rates not examined.	It was noted that plate waste was small (except for the egg dishes) indicating high consumption.	The ration was rated as marginally acceptable in its current form.
24.(Younger, Spencer and Dowman 1969)	Combat Ration Ten Man (CR10M) Light weight	Consumption was not directly measured, although plate waste and unconsumed food was monitored in one small group.	In this group wastage was low - only 5% was wasted if the egg dishes were not counted. On average, 68% of the egg dishes were wasted.	The ration was rated as unacceptable in its current form.

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Report	Ration concerned	Measurement of Consumption	Findings	Conclusion
25.(Poole 1968)	Combat Ration One Man (CR1M) Light weight	Consumption was not measured.	The results state the only items that were discarded or unconsumed were tea bags, coffee and chewing gum.	The ration was rated as successful in terms of acceptability and suitability
26.(Younger 1967b)	Combat Ration One Man (CR1M) Light weight	Food items that were discarded before the trial and unconsumed food during the trial was collected for analysis.	Curry powder, chocolate discs and service biscuits were the most commonly discarded items for the six day patrol. Service biscuits, jam filled biscuits, currant luncheon biscuits and chocolate discs were the most commonly discarded items for the eight day patrol. Main meals had low discard rates for both patrols. Consumption rates were calculated and the on average soldiers were consuming 1977 calories each day.	The ration was rated as successful in terms of acceptability, adequacy and suitability.
27.(Younger 1967a)	Patrol Ration	Consumption was not measured.	Consumption was not measured.	The ration was rated as less acceptable to this group.
28.(Younger 1966b)	Patrol Ration	Consumption was measured by collecting unconsumed food daily.	Consumption was high, with unconsumed food representing only a small percentage of the food provided. The most commonly discarded item was vegetable block, still with a small discard rate of 6.5%.	The ration was rated as highly acceptable, with only minor modifications required.
29.(Younger 1966a)	Various Rations	Consumption was indirectly measured, by analysing lists of items taken on patrol by soldiers. Although acknowledged to be only crudely scientific the figures were valuable for later ration design.	Items commonly taken (and assumed to be consumed) were coffee, sugar, meat blocks, soup powder and apple flakes.	The rations were not rated.
30.(Rayner ~1966)	Combat Ration One Man (CR1M)	Consumption was measured by recorded discarded items at both the beginning of the trial and during the trial.	Items commonly discarded were biscuits, margarine, cereal block, tea and rice. Discards were measured in terms of percentages of individual items (packets rejected divided by packets issued).	It was concluded that the ration was a very good one.
31.(Smith 1965)	Patrol Ration	Measured consumption at the end of each 24 hour period by counting unconsumed food.	Consumption was high, (unconsumed food was found to be negligible). The items returned in small amounts were ration biscuits, dehydrated cabbage, dehydrated beans, and curry powder.	The ration was rated as fair to good.

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Report	Ration concerned	Measurement of Consumption	Findings	Conclusion
32.(Smith 1964)	Training Ration Pack (Two Man)	Consumption was not measured.	Consumption was not measured.	The ration was rated as highly acceptable.
33.(Younger 1964)	Special Purpose Ration Pack	Measured consumption by counting returned (unconsumed) items, however exchanges were permitted for items of equivalent calorific value.	Items commonly returned were margarine, jam, mutton and beef bars, carrot, cabbage, and ration biscuits. Items rarely rejected were sweet biscuits and main meals.	The conclusion was that for up to eight days 2 800 Calories (11 700 kJ) was sufficient. Suggestions for items that should be included in a low calorie ration were given.
34.(Hutchinson 1962)	Light Weight (One Man) Ration Pack	Measured consumption by counting unconsumed items.	Items commonly unconsumed were tea, cheese, milk powder and ration biscuits. Items rarely returned were sweet biscuits and coffee.	The ration was found to be acceptable, requiring a few small changes.
35.(Hutchinson and McNaughton 1961)	Combat Ration Light Weight One Man	Measured consumption by counting returned items.	Items most commonly returned were instant desserts, instant milk, biscuits, cereal block, dehydrated mutton and beef, dehydrated vegetables and tomato sauce.	Concluded the ration had major shortcomings in terms of acceptability, adequacy and service suitability.
36.(Langtry and Munro 1955)	24hr Ration Pack (One Man)	Measured consumption by counting plate waste.	Items most commonly discarded were oatmeal block, nut food, fish loaf, sultanas and cereal, currants and cereal.	Concluded that although there were a few shortcomings, the ration was a 'good ration' when used over the intended time period of three to four days.

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Appendix C: Identification of the Factors in each Report

C.1. The Food

Key:

Yes	= report did contain findings related to this variable
No	= report did not contain findings related to this variable

Report	Portion Size	Temperature	Compatibilities	Quality/ Acceptance	Packaging/ Labelling	Presentation	Variety/ Monotony	Authenticity/ Country of Origin
<i>Does this factor have the potential to increase consumption?</i>	✓	✓	✓	✓	✓	✓	✓	?
<i>Does this factor have the potential to decrease consumption?</i>	✓	✓	✓	✓	✓	✓	✓	?
1. (Kullen <i>et al.</i> in preparation)	No	Yes	Yes	Yes	No	No	No	No
2. (McLaughlin and Hay in preparation)	Yes	No	No	Yes	No	No	No	No
3. (Probert, Bandara and Jayasena 2010)	No	Yes	Yes	Yes	No	No	Yes	No
4. (Carins and Thomson 2004)	Yes	Yes	Yes	Yes	No	No	Yes	No
5. (Carins 2002)	Yes	Yes	Yes	Yes	No	No	Yes	No
6. (McLaughlin and Thomson 2002)	Yes	Yes	No	Yes	No	No	Yes	No
7. (Forbes-Ewan 2001)	Yes	Yes	No	Yes	No	No	Yes	No
8. (Booth <i>et al.</i> 2001)	No	No	No	Yes	No	No	No	No
9. (Stephenson, Cavanough and Driver 1998)	Yes	Yes	No	Yes	No	No	Yes	No
10. (Driver <i>et al.</i> 1996)	Yes	Yes	Yes	Yes	No	No	Yes	No
11. (Forbes-Ewan, Morrissey and Waters 1988)	Yes	No	No	Yes	No	No	Yes	No
12. (Forbes-Ewan and Waters 1987)	Yes	No	Yes	Yes	No	No	Yes	No
13. (Forbes-Ewan and Waters 1986)	Yes	Yes	Yes	Yes	Yes	No	Yes	No
14. (Badcock 1985)	Yes	No	No	Yes	No	No	Yes	No
15. (Badcock and Lichtenstein 1981)	No	No	No	Yes	No	No	No	No
16. (Lichtenstein 1979b)	Yes	No	No	Yes	No	No	No	No
17. (Lichtenstein 1979a)	Yes	No	No	Yes	No	No	Yes	No

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Report	Portion Size	Temperature	Compatibilities	Quality/ Acceptance	Packaging/ Labelling	Presentation	Variety/ Monotony	Authenticity/ Country of Origin
<i>Does this factor have the potential to increase consumption?</i>	✓	✓	✓	✓	✓	✓	✓	?
<i>Does this factor have the potential to decrease consumption?</i>	✓	✓	✓	✓	✓	✓	✓	?
18. (Lichtenstein and Venkata-Raman 1979)	Yes	No	No	Yes	No	No	Yes	No
19. (Badcock and Lichtenstein 1978)	Yes	No	No	Yes	No	Yes	Yes	No
20. (Hutchinson, Gillis and Hope 1971)	Yes	No	No	Yes	No	No	Yes	No
21. (Hutchinson, Reck and McLelland 1970)	No	No	Yes	Yes	No	No	No	No
22. (Dowman, McLelland and Reck 1970)	Yes	Yes	Yes	Yes	Yes	No	Yes	No
23. (James and Row 1970)	Yes	No	No	Yes	No	No	No	No
24. (Younger, Spencer and Dowman 1969)	No	No	No	Yes	No	No	Yes	No
25. (Poole 1968)	Yes	No	No	Yes	No	No	No	No
26. (Younger 1967b)	Yes	No	No	Yes	No	No	Yes	No
27. (Younger 1967a)	Yes	No	No	Yes	No	No	No	No
28. (Younger 1966b)	Yes	No	No	Yes	No	No	Yes	No
29. (Younger 1966a)	No	No	No	Yes	No	No	No	No
30. (Rayner ~1966)	Yes	No	Yes	Yes	No	No	Yes	No
31. (Smith 1965)	Yes	No	Yes	Yes	No	No	No	No
32. (Smith 1964)	Yes	No	No	Yes	No	No	No	No
33. (Younger 1964)	No	No	No	Yes	No	No	No	No
34. (Hutchinson 1962)	Yes	No	No	Yes	No	No	No	No
35. (Hutchinson and McNaughton 1961)	Yes	No	No	Yes	No	No	No	No
36. (Langtry and Munro 1955)	No	Yes	No	Yes	No	Yes	Yes	No

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C.2. The Soldier

Key:

Yes	= report did contain findings related to this variable
No	= report did not contain findings related to this variable

Report	Age	Gender	Expectations	Religious Influences	Other Dietary Influences	Traits/ Attitudes	Cultural & Dietary Preferences	Commensality	Moods/ Emotions	Satiety
<i>Does this factor have the potential to increase consumption?</i>	?	✓	✓	?	?	✓	✓	✓	?	✓
<i>Does this factor have the potential to decrease consumption?</i>	?	✓	✓	✓	✓	✓	✓	✓	?	✓
1. (Kullen <i>et al.</i> in preparation)	No	No	No	No	No	No	No	No	No	No
2. (McLaughlin and Hay in preparation)	No	No	No	No	No	No	No	No	No	No
3. (Probert, Bandara and Jayasena 2010)	No	No	No	No	No	No	No	No	No	No
4. (Carins and Thomson 2004)	No	No	Yes	No	No	No	No	No	No	No
5. (Carins 2002)	No	No	No	No	Yes	No	No	No	No	No
6. (McLaughlin and Thomson 2002)	No	No	No	No	No	No	No	No	No	No
7. (Forbes-Ewan 2001)	No	No	No	No	Yes	No	No	No	No	No
8. (Booth <i>et al.</i> 2001)	No	No	No	No	No	No	No	No	Yes	No
9. (Stephenson, Cavanough and Driver 1998)	No	No	No	No	No	No	No	No	No	No
10. (Driver <i>et al.</i> 1996)	No	No	No	No	No	No	No	No	No	No
11. (Forbes-Ewan, Morrissey and Waters 1988)	No	No	No	No	No	No	No	No	No	No
12. (Forbes-Ewan and Waters 1987)	Yes	No	Yes	No	No	No	No	No	No	No
13. (Forbes-Ewan and Waters 1986)	No	No	No	No	No	No	No	No	No	No
14. (Badcock 1985)	No	No	No	No	No	No	No	No	No	No
15. (Badcock and Lichtenstein 1981)	No	No	No	No	No	No	No	No	No	No
16. (Lichtenstein 1979b)	No	No	No	No	No	No	No	No	No	No
17. (Lichtenstein 1979a)	No	No	No	No	No	No	No	No	No	No
18. (Lichtenstein and Venkata-Raman 1979)	No	No	No	No	No	No	No	No	No	No
19. (Badcock and Lichtenstein 1978)	No	No	No	No	No	No	No	No	No	No
20. (Hutchinson, Gillis and Hope 1971)	No	No	No	No	No	No	No	No	No	Yes
21. (Hutchinson, Reck and McLelland 1970)	No	No	No	No	No	No	No	No	No	No

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Report	Age	Gender	Expectations	Religious Influences	Other Dietary Influences	Traits/ Attitudes	Cultural & Dietary Preferences	Commensality	Moods/ Emotions	Satiety
<i>Does this factor have the potential to increase consumption?</i>	?	✓	✓	?	?	✓	✓	✓	?	✓
<i>Does this factor have the potential to decrease consumption?</i>	?	✓	✓	✓	✓	✓	✓	✓	?	✓
22. (Dowman, McLelland and Reck 1970)	No	No	No	No	No	No	No	No	No	Yes
23. (James and Row 1970)	Yes	No	Yes	No	No	No	No	No	No	No
24. (Younger, Spencer and Dowman 1969)	No	No	No	No	No	No	No	No	No	No
25. (Poole 1968)	No	No	No	No	No	No	No	No	No	No
26. (Younger 1967b)	No	No	No	No	No	No	No	No	No	No
27. (Younger 1967a)	No	No	No	No	No	No	No	No	No	No
28. (Younger 1966b)	No	No	No	No	No	No	Yes	No	No	No
29. (Younger 1966a)	No	No	No	No	No	No	No	No	No	No
30. (Rayner ~1966)	No	No	No	No	No	No	No	No	No	No
31. (Smith 1965)	No	No	No	No	No	No	Yes	No	No	Yes
32. (Smith 1964)	No	No	No	No	No	No	No	No	No	No
33. (Younger 1964)	No	No	No	No	No	No	No	No	No	No
34. (Hutchinson 1962)	No	No	No	No	No	No	No	No	No	Yes
35. (Hutchinson and McNaughton 1961)	No	No	No	No	No	No	No	Yes	No	Yes
36. (Langtry and Munro 1955)	No	No	No	No	No	No	No	No	No	Yes

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C.3. The Environment

Key:

Yes	= report did contain findings related to this variable
No	= report did not contain findings related to this variable

Report	Appropriateness	Time of Day	Choice	Location	Comfort vs. stress	Temperature/ weather	Speed of Eating/ Meal Duration	Convenience	Price, Value, Free Food
<i>Does this factor have the potential to increase consumption?</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Does this factor have the potential to decrease consumption?</i>	✓	✓	✓	✓	✓	✓	✓	✓	?
1. (Kullen <i>et al.</i> in preparation)	Yes	No	No	No	No	Yes	No	Yes	No
2. (McLaughlin and Hay in preparation)	Yes	No	No	No	No	No	No	Yes	No
3. (Probert, Bandara and Jayasena 2010)	No	No	No	No	No	Yes	No	Yes	No
4. (Carins and Thomson 2004)	Yes	No	No	No	No	No	No	Yes	No
5. (Carins 2002)	Yes	No	No	No	No	Yes	No	Yes	No
6. (McLaughlin and Thomson 2002)	No	No	No	No	No	No	No	Yes	No
7. (Forbes-Ewan 2001)	Yes	No	No	No	No	No	No	Yes	No
8. (Booth <i>et al.</i> 2001)	No	No	Yes	No	No	No	No	No	No
9. (Stephenson, Cavanough and Driver 1998)	Yes	No	No	No	No	No	Yes	Yes	No
10. (Driver <i>et al.</i> 1996)	Yes	No	No	No	No	No	No	Yes	No
11. (Forbes-Ewan, Morrissey and Waters 1988)	No	No	No	No	No	No	No	No	No
12. (Forbes-Ewan and Waters 1987)	No	No	No	No	No	Yes	No	No	No
13. (Forbes-Ewan and Waters 1986)	Yes	No	No	No	No	No	No	No	No
14. (Badcock 1985)	No	No	No	No	No	Yes	No	No	No
15. (Badcock and Lichtenstein 1981)	Yes	No	No	No	No	No	No	Yes	No
16. (Lichtenstein 1979b)	Yes	No	No	No	No	No	No	Yes	No
17. (Lichtenstein 1979a)	Yes	No	No	No	No	No	No	No	No
18. (Lichtenstein and Venkata-Raman 1979)	No	No	No	No	No	No	No	No	No
19. (Badcock and Lichtenstein 1978)	Yes	No	No	No	No	No	No	Yes	No

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Report	Appropriateness	Time of Day	Choice	Location	Comfort vs. stress	Temperature/ weather	Speed of Eating/ Meal Duration	Convenience	Price, Value, Free Food
<i>Does this factor have the potential to increase consumption?</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Does this factor have the potential to decrease consumption?</i>	✓	✓	✓	✓	✓	✓	✓	✓	?
20. (Hutchinson, Gillis and Hope 1971)	Yes	No	No	No	No	No	No	Yes	No
21. (Hutchinson, Reck and McLelland 1970)	No	No	No	No	No	Yes	No	No	No
22. (Dowman, McLelland and Reck 1970)	Yes	No	No	No	No	No	No	Yes	No
23. (James and Row 1970)	Yes	No	No	No	No	No	No	Yes	No
24. (Younger, Spencer and Dowman 1969)	No	No	No	No	No	No	No	Yes	No
25. (Poole 1968)	Yes	No	No	No	No	No	No	Yes	No
26. (Younger 1967b)	Yes	No	No	No	No	No	No	Yes	No
27. (Younger 1967a)	Yes	No	No	No	No	No	No	Yes	No
28. (Younger 1966b)	Yes	No	No	No	No	No	No	Yes	No
29. (Younger 1966a)	No	No	No	No	No	No	No	Yes	No
30. (Rayner ~1966)	Yes	No	No	No	No	No	No	No	No
31. (Smith 1965)	No	No	No	No	No	No	No	No	No
32. (Smith 1964)	No	No	No	No	No	No	No	Yes	No
33. (Younger 1964)	No	No	Yes	No	No	No	No	Yes	No
34. (Hutchinson 1962)	Yes	No	No	No	No	No	No	Yes	No
35. (Hutchinson and McNaughton 1961)	No	No	No	No	No	No	No	Yes	No
36. (Langtry and Munro 1955)	Yes	No	No	No	No	Yes	No	No	No

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Appendix D: Description of findings for each Factor

D.1. The Food

Report	Portion Size
2. (McLaughlin and Hay in preparation)	Adequacy of individual items was tested using a three point scale from “not enough” to “too much”. The majority of responses fell in the ‘enough’ category for most items. Items that were rated as “not enough” included coffee, trail mix, sweetened condensed milk, sports beans, crackers, tuna, jerky and tortilla bread.
4. (Carins and Thomson 2004)	Adequacy of individual items was not tested, but asked about adequacy of main meals, snack items, sweet items, cold drinks, and hot drinks. The majority thought all of these classes of items were provided in sufficient quantities. Questioned how the PRIM met soldiers overall food needs (very bad to very good) during the exercise – the majority answered good.
5. (Carins 2002)	Adequacy of individual items was not tested. Found that 56% of soldiers thought that the size of main meals was ‘a good size’, 63% thought amount of snacks was ‘OK’, 59% thought there to be enough cold drinks and 54% thought there was enough hot drinks.
6. (McLaughlin and Thomson 2002)	Adequacy of individual items was tested using a three point scale from “not enough” to “too much”. The majority of responses fell in the ‘enough’ category for every item.
7. (Forbes-Ewan 2001)	Adequacy of individual items was not tested. Main meals were considered to be too small. About one third stated that there were not enough cold drinks and not enough snacks. Overall the ration was rated as fair to poor in terms of meeting the need for food.
9. (Stephenson, Cavanough and Driver 1998)	Adequacy of some items was tested using a 3 point scale from ‘too much’ to ‘not enough’. The overall ration was rated as having enough food.
10. (Driver <i>et al.</i> 1996)	Adequacy of most items was tested using a 3 point scale from ‘too much’ to ‘not enough’. Soldiers generally thought the quantities provided in the IMCR were adequate. They requested more chewing gum.
11. (Forbes-Ewan, Morrissey and Waters 1988)	Adequacy of most items was tested using a 3 point scale from ‘too much’ to ‘not enough’. Some desired an increase in the following items – biscuits (30%), fruit drink powder (25% if current flavour retained and 75% if flavour is improved), sweetened condensed milk (36%), and sweets (33%). Most (71%) thought there was enough food in the pack.
12. (Forbes-Ewan and Waters 1987)	Adequacy of most items (cereal supplement, soups, canned vegetables, spreads, tea, coffee, sugar, sweetened condensed milk, main meals) was tested using a 3-point scale from ‘too much’ to ‘not enough’. Some desired an increase in the following items – biscuits (34%), soup (31%), coffee (52%), sugar (30%), and sweetened condensed milk (52%). Main meals were generally considered adequate, as were vegetables. For the pack overall, 33.5% considered quantity to be adequate including cereal supplement and 29.1% believed amount adequate without cereal supplement.
13. (Forbes-Ewan and Waters 1986)	Adequacy of individual items was not tested. Soldiers were divided as to whether there should be more total food in the ration pack.
14. (Badcock 1985)	Demand for items was measured using a 3 point scale from “not enough” to “discarded it”. Items that received ratings on the “not enough” end of the range included bread, canned fruit, brew gear, pudding, cake and meat products.
16. (Lichtenstein 1979b)	Adequacy of individual items was tested using a three point scale from “not enough” to “too much”. Items considered to be provided in insufficient quantities included cheese, sweetened condensed milk, coffee, canned fruit and some main meals. Few respondents considered any items to be present in excess.

Report	Portion Size
17. (Lichtenstein 1979a)	Adequacy of individual items was tested using a three point scale from "not enough" to "too much". Items considered to be provided in insufficient quantities by all groups included cheese, sweetened condensed milk, brew gear, chocolate, sweet biscuits and some main meals. Some groups desired more rice. Items thought to be present in excess were survival biscuits, sugar, and luncheon meat but these results were not conclusive.
18. (Lichtenstein and Venkata-Raman 1979)	Adequacy of each item was not reported. The reduced size of the main meals seemed adequate to most users. The amount of (new) raisins was deemed to be insufficient by 96% of users.
19. (Badcock and Lichtenstein 1978)	Adequacy of individual items was tested using a three point scale from "not enough" to "too much". Items thought to be present in insufficient amounts in the PR1M were: brew gear, fruit drink powders, biscuits and cheese; and in the CR1M: survival biscuits. Items thought to be provided in excess in the PR1M were: sugar and in the CR1M: sweet biscuits, cheese, sweetened condensed milk, brew gear, rice, main meals.
20. (Hutchinson, Gillis and Hope 1971)	Adequacy of individual items was not tested, however soldiers were asked which items they would like to see increased or decreased to improve that ration. Soldiers desired an increase in the amount of rice, coffee, tea bags, sugar, biscuits, fruit drink powder. They also wanted a decrease in the amount of freeze dried meat and brown gravy and vegetable flavour blocks.
22. (Dowman, McLelland and Reck 1970)	Adequacy of individual items was not tested. Some commented that the ration completed satisfied the men, others considered that there was not enough food in the ration for men engaged in strenuous work.
23. (James and Row 1970)	Adequacy of individual items was not tested. For the overall ration, out of seven companies all found the amount of food adequate except one company where distribution was thought to be the issue.
25. (Poole 1968)	Adequacy of individual items was not tested, but the overall ration was rated as adequate by 69% (variety D) and 73% (variety E) of soldiers. Soldiers reported that they would have eaten more of the meals if provided as they were extremely palatable.
26. (Younger 1967b)	Adequacy of individual items was not tested, but for overall ration adequacy 95% thought the ration provided enough food.
27. (Younger 1967a)	Adequacy of individual items was not tested. Most thought the ration provided adequate food overall, only 10% thought that there was 'too little'.
28. (Younger 1966b)	There was a demand for more rice and sugar. All soldiers reported having adequate food - but the majority still lost weight.
30. (Rayner ~1966)	Adequacy of individual items was not tested, but for overall ration adequacy it was found there was 'enough' food in the experimental ration, averaging 3.19 when rated on a 5 point scale (from 1 - much too little to 5 - much too much).
31. (Smith 1965)	Sufficiency for each ration item was tested using a 3 point scale from 'too much' to 'not enough'. Most items were rated as having insufficient quantities, including rice, biscuits, chocolate, and dried vegetables. All ration menus were considered to contain insufficient food.
32. (Smith 1964)	Sufficiency for each ration item was tested, the majority of items were considered to have sufficient quantities. More coffee was desired.
34. (Hutchinson 1962)	Soldiers were asked to list the items they thought were insufficient. Sugar and coffee were regularly listed. Adequate food was considered to be present in the ration overall.
35. (Hutchinson and McNaughton 1961)	The majority thought there was sufficient food in the overall ration.

Report	Food Temperature
1. (Kullen <i>et al.</i> in preparation)	Main meals that did not require heating were more acceptable and had the highest consumption of the main meals.
3. (Probert, Bandara and Jayasena 2010)	In the 2003 survey, 87% stated that main meals should be able to be eaten cold, but 83% stated that having hot meals was important.

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Report	Food Temperature
4. (Carins and Thomson 2004)	The majority stated that it was important to them to be able to eat FD meals warm, but were not always able to do so.
5. (Carins 2002)	Soldiers were evenly divided as to whether it was important to them to heat food items, but 84% said they heat meals sometimes, often or always.
6. (McLaughlin and Thomson 2002)	Asked whether it was difficult to heat different meal types. The majority had no difficulty with freeze dried meals, cans or retort pouches. A greater percentage had trouble with retort pouches, although this still represented a minority.
7. (Forbes-Ewan 2001)	Heating food was stated to be important to 55%, and 92% were able to heat their food sometimes or often.
9. (Stephenson, Cavanough and Driver 1998)	Potato and onion could not be eaten cold. There was a clear desire for a main meal that could be eaten cold.
10. (Driver <i>et al.</i> 1996)	Asked whether the meals were edible cold, about one third responded that they were not.
13. (Forbes-Ewan and Waters 1986)	One of the most common comments was that rations needed to be edible hot and cold, and that some main meals were unpalatable when cold.
22. (Dowman, McLelland and Reck 1970)	Found that food had to be prepared and then eaten hot. It couldn't be eaten cold straight from the packet.
36. (Langtry and Munro 1955)	The contribution of food temperature to the appeal of each item was considered

Report	Meal Components (Food compatibilities)
1. (Kullen <i>et al.</i> in preparation)	Compared two rations – the current meal-based CR1M and the snack-based HWR, and found the snack-based ration more acceptable and better consumed.
3. (Probert, Bandara and Jayasena 2010)	In the 2003 survey, 72% stated that there was a lack of specific breakfast items.
4. (Carins and Thomson 2004)	Majority (57%) thought that there was not a specific breakfast item.
5. (Carins 2002)	The majority stated there was not really anything to make into breakfast.
10. (Driver <i>et al.</i> 1996)	There was a preference for a main meal in every IMCR menu. A menu composed entirely of snacks was not considered appropriate. CR5M – there was a clear desire for a new group feeder that also had the capacity to individually feed, rather than a true group feeder. The majority also wanted foods specifically designed for breakfast. Spreads provided in the CR5M were found to be of no use, because a cereal supplement was not provided regularly.
12. (Forbes-Ewan and Waters 1987)	The spreads were considered useless when the cereal supplement (bread/biscuits) was not issued (cereal supplement was not issued to 38% of respondents). There was a desire for specific breakfast items – porridge or breakfast cereal.
13. (Forbes-Ewan and Waters 1986)	There was a demand by all groups for larger breakfast meals.
21. (Hutchinson, Reck and McLelland 1970)	There was a desire for 3 main meals; this is being addressed by increasing the size of the existing main meals.
22. (Dowman, McLelland and Reck 1970)	Macaroni Cheese not a suitable breakfast item, if it had meat mixed with it, it might be more acceptable for breakfast.

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Report	Meal Components (Food compatibilities)
30. (Rayner ~1966)	Proposed adoption of a midday meal that requires no cooking (a midday snack).
31. (Smith 1965)	Rice was more desirable to the Pacific Islanders than the Australians.

Report	Food Quality/Acceptance
1. (Kullen <i>et al.</i> in preparation)	Tested acceptability of each item using a 5 point scale. HWR items more acceptable than CR1M. Popular items were sweet and savoury biscuits, protein bars, jerky, trail and nut mixes, protein drinks, sports drinks and main meals (non-heating). Unpopular items were retort main meals, and soup powders.
2. (McLaughlin and Hay in preparation)	Tested acceptability of each item using a 5 point scale. Most items were well liked, except for ration chocolate and chocolate powergel.
3. (Probert, Bandara and Jayasena 2010)	Tested acceptability using a 9 point scale in 1998, and using a 5 point scale in 2003. Highly acceptable items were biscuits, cheese and chocolate (1998), and cheese, canned fruit, some main meals, sweetened condensed milk and biscuits (2003). Unacceptable items were soup and tropical muesli bar (1998) and soup, ANZAC muesli bar, sports drinks, curry powder, butter concentrate, vegetable extract and some main meals (2003).
4. (Carins and Thomson 2004)	Tested acceptability of each item using a 5 point scale. Acceptable items were biscuits, main meals, fruit grains, chocolate powder, sweetened condensed milk, noodles and beverage powders. Unacceptable items were rice, ration chocolate, potato and onion powder, ANZAC biscuit, and curry powder.
5. (Carins 2002)	Tested acceptability of each item using a 9 point scale. Acceptable items were most main meals, biscuits, fruit grains and canned fruit, noodles, cheese and confectionery. Unacceptable items were soups, freeze dried rice, potato and onion powder.
6. (McLaughlin and Thomson 2002)	Tested acceptability of each item using a 9 point scale. Fruit grains, tinned fruit, main meals and biscuits were found to be generally acceptable. Soup powders, sports drinks and curry powders were found to be not acceptable.
7. (Forbes-Ewan 2001)	Acceptability of each item was not tested. The most common reason for discarding items was <i>don't like</i> . Foods commonly discarded were muesli bars, baked beans, chocolate, candy and rice. The acceptability of CR1M reduced over time for 93%, 64% of which said acceptance 'dropped greatly.' CR1M doesn't rate highly as a long term feeding option. The taste of cold drinks was an issue. Main meals were too bland. Melting chocolate is common.
8. (Booth <i>et al.</i> 2001)	Acceptability of each item was not tested. The acceptability of two high CHO energy supplements were tested, a bar and a drink both of which were found to be mediocre.
9. (Stephenson, Cavanough and Driver 1998)	Tested acceptability of items using a 5 point scale. Biscuits, muesli bars, noodles and main meals were all acceptable. Rice and potato and onion powder were unacceptable.
10. (Driver <i>et al.</i> 1996)	Tested acceptability of some items in the existing rations – not the revised prototypes. For the IMCR most items scored well. For the CR5M cereal supplement, pasta, bread and noodles were preferred over rice and biscuits. Popular CR5M items included fruit, pudding, biscuits, chocolate, confectionary, cheese and spreads. Most main meals were rated fair. Items that were rated below fair were soup and ham and eggs.
11. (Forbes-Ewan, Morrissey and Waters 1988)	Acceptability was tested using either a five point scale or a yes/no option. Main meals, biscuits and sweets were found to be acceptable. Fruit flavoured cordial was the least acceptable.
12. (Forbes-Ewan and Waters 1987)	Acceptability was tested using either a five or three point scale or a yes/no option. Items that were popular were vegetables, vegemite, jam, fruit and puddings. Items of marginal acceptance included tea/coffee and most main meals. Items of poor acceptance include butter concentrate, luncheon meat, beef and kidney and corned beef.

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Report	Food Quality/Acceptance
13. (Forbes-Ewan and Waters 1986)	Acceptability was tested using a five point scale for main meals and canned fruit, and a yes/no option for other items. Items that were found to be popular included shortbread biscuits, chocolate drink, fruit and confectionary. Items of marginal acceptance included most main meals, rice and potato and onion powder. Items that were found to be not acceptable included luncheon meat, corned beef, beverage based powder, butter concentrate, butterscotch and cereal block. Dislike, too fatty, too salty and bland were common reasons for low acceptability.
14. (Badcock 1985)	Acceptability was assessed using a 5 point scale (-2 to +2). There were items found to be very popular, very unpopular and of intermediate acceptability. Canned fruit has a very high acceptability. Popular items included bread, fruit, coffee, condensed milk, pudding and cake. Items of marginal/moderate acceptance included most main meals, vegetables, rice, jam, biscuits, tea and butter concentrate. Items of poor acceptability included soup, chopped pork and cereal, corned beef, steak and kidney and red kidney beans.
15. (Badcock and Lichtenstein 1981)	Acceptability was assessed using a 5 point scale (-2 to +2). Popular items included soup cubes, biscuits, cheese, cereal block, butterscotch and fruit candy. Coffee, beef block and milk powder were the least popular items.
16. (Lichtenstein 1979b)	Acceptability was assessed using a 5 point scale (-2 to +2). Highly acceptable items included canned fruit, sweetened condensed milk, cheese, and brew gear. Items of marginal acceptance included rice, most main meals and chocolate. Butterscotch, survival biscuits, cereal block and fruit drink powders were all unacceptable.
17. (Lichtenstein 1979a)	Acceptability was assessed using a 5 point scale (-2 to +2). Highly acceptable items included sweet biscuits, cheese, chocolate, sweetened condensed milk, brew gear, rice, potato and onion powder and spreads. Items of marginal/moderate acceptance included butter concentrate and most main meals. Items considered unacceptable included cereal block, survival biscuits, camp pie, corned beef, fruit drink powders, luncheon meat and candy creamy fudge. Rice was discarded by 81% (75/76 RPP) and 57% (76/77 RPP) of users.
18. (Lichtenstein and Venkata-Raman 1979)	Acceptability was assessed using a 5 point scale (-2 to +2). There were problems with meat reconstitution, and menus all tasting the same. Items with high acceptability included mince and spaghetti, potato and onion powder and raisins. Items of marginal/moderate acceptance included chocolate, most main meals and rice. Items of poor acceptance included candy creamy fudge and sweet and sour pork.
19. (Badcock and Lichtenstein 1978)	Acceptability was assessed using a 5 point scale (-2 to +2). Sweet and Sour Pork, instant milk and candy creamy fudge were unacceptable in the PR1M; and the survival biscuits, cereal block and candy creamy fudge were unacceptable in the CR1M. Flavours and textures were criticised in the main meals (of both rations). They were compared to cardboard, and thought to be too monotonous. The FD meat was difficult to reconstitute. Poor quality ingredients were used, especially the meat which contained excess fat, gristle, blood vessels and sinews. The biscuits were criticised for being too easily crushed, dry and bland.
20. (Hutchinson, Gillis and Hope 1971)	Acceptability of all items was assessed using a 5 point scale. All items rated well, biscuits, chocolate and sweetened condensed milk all rated highly.
21. (Hutchinson, Reck and McLelland 1970)	A 5 point scale was used to determine the acceptability of the main meals. All main meals were highly accepted except corned beef. Tea bags were preferred to instant tea and instant milk was preferred over coffee creamer.
22. (Dowman, McLelland and Reck 1970)	Acceptability was tested using a five point scale. Most items were rated as acceptable, except macaroni cheese. Soldiers had issues with meal textures; meat being too small; and having nothing to chew on. Some foods were perceived to be flavourless.
23. (James and Row 1970)	The 9 point hedonic scale was used. Scrambled and curried eggs were disliked. Apple and custard, porridge and mashed potato were all liked. Items of moderate acceptability were main meals, choc chip dessert, rice, bread and scones.
24. (Younger, Spencer and Dowman 1969)	The 9 point hedonic scale was used. Only 5 out of 12 items were found to be acceptable (scoring 5 or more out of 9). The egg dishes were the least acceptable.
25. (Poole 1968)	Each item was rated as acceptable rating 3 (or more) out of 5. The dehydrated meals rated higher than freeze dried meals.
26. (Younger 1967b)	All items were found to be acceptable, that is scoring a rating of 3 (or more) out of 5.

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Report	Food Quality/Acceptance
27. (Younger 1967a)	Acceptability was good to fair - 43.6% rated as good and 35.9% rated as fair.
28. (Younger 1966b)	The ration overall had high acceptability. Rice was popular. Sausages and vegetables, mixed vegetable block ration biscuits and steak and egg all rated poorly.
29. (Younger 1966a)	Rice was not popular neither was lemonade powder. Freeze dried meat was popular.
30. (Rayner ~1966)	The new pack rated better than the current CR1M when rated on a 5 point scale (from 1 - much worse to 5 - much better). Liked foods included tuna, rice, Irish stew, disliked foods included Vienna Sausages. Rejected foods included biscuits, margarine and cereal blocks. Solid meats were listed as liked as often as they were listed as disliked.
31. (Smith 1965)	Items were well accepted. They were all rated fair to good. More popular items were chocolate, fruit biscuits and rice, less popular were ration biscuits dehydrated cabbage, dehydrated beans and canned mixed beans.
32. (Smith 1964)	Ration overall was found to be highly acceptable. Popular items were coffee, condensed milk, orange juice, Irish stew, peas, vegetables and meatballs. Unpopular items were ravioli and tomato sauce corn beef and sweet corn, although these were still acceptable to more than half the participants
33. (Younger 1964)	Dehydrated meals not acceptable due to toughness, poor taste and long preparation time. The dehydrated cabbage and carrot, ration biscuits, jam and margarine were also rated as poor. Popular items were the confectionary jam filled and currant luncheon biscuits.
34. (Hutchinson 1962)	The ration was generally accepted. Popular items included jam and cream filled biscuits chocolate discs and instant rice. Unpopular items were cheese with bacon, noodles and mulligatawny. Items needing improvement were meat bars cheese and instant milk.
35. (Hutchinson and McNaughton 1961)	The pack was rated as fair, but the authors concluded it was not satisfactory with respect to acceptability, adequacy or service suitability. Cheese was a popular item. Items regarded as poor were instant milk instant desserts, ration biscuits and candy. The beef and mutton blocks were liked by one group and not the other.
36. (Langtry and Munro 1955)	The pack was rated as good. Items rated as poor were nut food, fish loaf, oatmeal block, currants and cereal, sultanas and cereal. Biscuits were considered to be borderline. Many of these items were considered to have poor texture.

Report	Food Packaging and Labelling
13. (Forbes-Ewan and Waters 1986)	The authors discussed the inclusion of nutrition information on the packaging/instruction sheets to enable the soldier to be better informed when making discards.
22. (Dowman, McLelland and Reck 1970)	Some fruit drink packets were unbranded, soldiers could not determine what flavour was contained in the packet.

Report	Food Presentation
19. (Badcock and Lichtenstein 1978)	The main meals were considered to have an unappetising appearance.
36. (Langtry and Munro 1955)	Many of the foods were considered to have poor appearance; rehydration issues and separation of fat where noted.

Report	Food Variety and Monotony
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Report	Food Variety and Monotony
3. (Probert, Bandara and Jayasena 2010)	A small majority (54%) stated that there was enough variety in the ration.
4. (Carins and Thomson 2004)	The majority (63%) thought that there was enough variety in the ration.
5. (Carins 2002)	A slight majority (57%) thought there was enough variety in the ration.
6. (McLaughlin and Thomson 2002)	There were some requests for more variety given in the free comments.
7. (Forbes-Ewan 2001)	Most (73%) thought there wasn't enough variety between menus.
9. (Stephenson, Cavanough and Driver 1998)	About half of the soldiers would like to see more variety in the biscuits and cereals, and 28% would like to see more variety in the ration generally.
10. (Driver <i>et al.</i> 1996)	An increase in variety for chewing gum and candy was requested.
11. (Forbes-Ewan, Morrissey and Waters 1988)	Directly examined variety for sweets and biscuits. Found more variety was desired for both sweets (54%) and biscuits (53%).
12. (Forbes-Ewan and Waters 1987)	Directly examined variety for desserts. There was an overwhelming demand for greater variety in desserts (81%). Comments were received that a greater range of condiments is needed, and the variety of main meals could be increased.
13. (Forbes-Ewan and Waters 1986)	Directly examined variety for biscuits, confectionary, meats/main meals and canned fruits. More variety was considered necessary for biscuits (76%), confectionary (79%), and fruit (58%). There was also a desire for more condiments to be added (82%), and a common complaint was lack of variety in the menus. Most soldiers considered 10-15 menus would be appropriate.
14. (Badcock 1985)	Comments that there was not enough variety in the meat products - that all are very similar.
17. (Lichtenstein 1979a)	Criticisms were expressed that there is a lack of variety in the menus, and there should be more variety in the sweets.
18. (Lichtenstein and Venkata-Raman 1979)	Criticisms were made that the PR1M has become 'very boring and monotonous', menus are not changed enough, and the menus are too similar in taste and appearance.
19. (Badcock and Lichtenstein 1978)	Flavour of the main meals considered monotonous in both CR1M and PR1M.
20. (Hutchinson, Gillis and Hope 1971)	Ration was considered to be too monotonous.
22. (Dowman, McLelland and Reck 1970)	The meat dishes were criticised for being indistinguishable due to similar colour and texture. Texture was monotonous. Due to a shortage of time and limited cooking equipment, variety in the meals was not achieved; every meal was meat and potato/rice. More variety was desired in the sauces, soups and condiments.
24. (Younger, Spencer and Dowman 1969)	Main meal texture, taste and appearance were criticised for being monotonous.
26. (Younger 1967b)	Although not asked in the questionnaire, it was recommended that further varieties of the ration be developed.
28. (Younger 1966b)	The varieties in the ration were too similar it was feared that this would be a problem over lengthy periods of issue. More canned meats were required to create more variety, and some new varieties were suggested.
30. (Rayner ~1966)	The pack was designed to include more variety, moving to 5 menus instead of three.
36. (Langtry and Munro 1955)	The majority considered there to be enough variety in the pack.

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D.2. The Soldier

Report	Age
12. (Forbes-Ewan and Waters 1987)	Kidney and offal are not liked by the younger generation, they were commonly used by older generations, but now they are no longer traditionally consumed, and this was reflected in the low acceptability and consumption rates.
23. (James and Row 1970)	Divided ages into under and over 23 year olds. The younger age group disliked the egg dishes more, and more often stated that there was not enough food.

Report	Expectations
4. (Carins and Thomson 2004)	The majority stated that the PR1M should contain energy drinks (76%) and energy bars (82%). They were evenly divided as to whether it should contain canned fruit.
12. (Forbes-Ewan and Waters 1987)	Kidney and offal are not liked by the younger generation, they were commonly used by older generations, but now they are no longer traditionally consumed, and this was reflected in the low acceptability and consumption rates.
23. (James and Row 1970)	Divided ages into under and over 23 year olds. The younger age group disliked the egg dishes more, and more often stated that there was not enough food.

Report	Other Dietary Influences (Vegetarian)
5. (Carins 2002)	Need for a vegetarian menu was supported by 22%.
7. (Forbes-Ewan 2001)	Need for more vegetarian food was only supported by 5%.

Report	Cultural & Dietary Preferences/Aversions
28. (Younger 1966b)	This modified ration was designed to be suitable for both Pacific Islanders and Australians, and was found to be acceptable to both cultural groups.
31. (Smith 1965)	They tested the ration with Pacific Islanders and Australians, it was found to be acceptable to both. The Pacific Islanders prefer more rice than the Australians. The report made suggestions for rations that would be acceptable to both cultural groups.

Report	Commensality
35. (Hutchinson and McNaughton 1961)	Suspected that group influence contributed to a higher than usual rate of return of meat blocks from one of their groups, noting that "several of them were very outspoken in expressing their dislike of the meat blocks to the project officer. No doubt they were even more outspoken to their companions".

Report	Moods and Emotions
8. (Booth <i>et al.</i> 2001)	Mood states were measured, and changes over time were detected, however there were no significant differences between the treatment groups.

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Report	Satiety
20. (Hutchinson, Gillis and Hope 1971)	Soldiers commented that the ration lacked satiety.
22. (Dowman, McLelland and Reck 1970)	The rations seemed to satisfy the hunger of the soldiers in the Light Aid Detachment as there was no tendency to snack between meals, however the ration was considered insufficient for those engaged in very strenuous work by those from 12 Field Regiment.
31. (Smith 1965)	Satiety was tested. All rations were said to contain insufficient food.
34. (Hutchinson 1962)	Each man was satisfied after each meal.
35. (Hutchinson and McNaughton 1961)	Troops were more hungry as the trial progressed, but these troops who complained of increased hunger didn't necessarily lose weight.
36. (Langtry and Munro 1955)	Satiety was gauged by observing natural appetite.

D.3. The Environment

Report	Appropriateness
1. (Kullen <i>et al.</i> in preparation)	HWR ration was designed to suit hot environment and tested against current CR1M to determine success. It was found to be better consumed and more acceptable.
2. (McLaughlin and Hay in preparation)	Asked soldiers to rate whether weight, size, packaging and water required to reconstitute was too much, manageable or ideal. Half of the soldiers considered the ration manageable with respect to these issues; the other half rated it ideal.
4. (Carins and Thomson 2004)	The majority of soldiers (80%) did not feel that there were problems with the packaging of the PR1M. However some did identify problems under the provided headings of noisy (22%) and lack of camouflage (8%).
5. (Carins 2002)	Tested infantry vs. non-infantry. Generally infantry personnel rated items higher for acceptability, some significantly. Infantry personnel responded more strongly 'no' to the questions 'should there be more sweet things?' and 'should there be a vegetarian menu?' They also answered more negatively to the question 'do you take jack rations?', although the majority of infantry still took jack rations.
7. (Forbes-Ewan 2001)	The majority (76%) were dissatisfied with the packaging – required improvements included better camouflage, stronger packaging (for biscuits and tubes), and removal of the cans. The CR1M was considered to be heavy and bulky by 87% of soldiers.
9. (Stephenson, Cavanough and Driver 1998)	About two thirds stated that a light weight ration would be suitable for their use. About half stated there were times when the ration was not suitable, including those where water supply was limited, and where the ration was used for long periods. Whilst weight was not considered to be an issue, the ration was considered to be too bulky by about one quarter of respondents. Many complained about the amount of waste.
10. (Driver <i>et al.</i> 1996)	IMCR – when asked to give a preference between cans (no water required) and freeze dried meals (require the addition of water), soldiers in the hotter northern areas preferred cans, even though the requirement for 'no rehydration' of IMCR items was not scored highly. The increased water requirement was the factor used in the argument against the used of dried items. The provision of lightweight pouches was considered important. CR5M – pouches were deemed to be suitable packaging, but respondents from Darwin showed a higher preference for cans. Soldiers considered 5 people the best number to be fed with a group feeding ration.
13. (Forbes-Ewan and Waters 1986)	Packaging was considered suitable by the majority (74%). Common suggestions for improvement were having a sealable outer bag, reducing the total packaging.

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Report	Appropriateness
15. (Badcock and Lichtenstein 1981)	Water food bag inadequate strength, sweet wrappers stuck to sweets, matches less than ideal and the water sterilisation packaging hard to open.
16. (Lichtenstein 1979b)	The questionnaire asked whether the packaging was alright, too shiny, too crackly, too flimsy or too bulky for each item. Few items were considered to have these problems. The exception was the main meals which were considered to be too shiny. Some considered that all items should be packed in camouflaged materials.
17. (Lichtenstein 1979a)	Comments were made that the canned fruit containers were considered to be too flimsy, that cans should be made of a lighter material, and a resealable bag for the CR1M should be included.
19. (Badcock and Lichtenstein 1978)	Criticism of the amount of water required to be carried for the PR1M and this was not appropriate in drier climates. Packaging of items was considered too shiny for tactical conditions, and there were adverse camouflage and flammability aspects to the packaging. Taints from the packaging were found, and often flavours came through from nearby items.
20. (Hutchinson, Gillis and Hope 1971)	The packaging and non-edible items represent 20% of the ration weight which was considered to be an area for improvement.
22. (Dowman, McLelland and Reck 1970)	Some problems with leakages.
23. (James and Row 1970)	Some outer tins burst after the air drop, however individual items were unaffected.
25. (Poole 1968)	An inferior laminate was used (due to unavailability of the correct laminate at the time) which had problems such as punctures and catching on fire when heated. The proper laminate has no reports of this so it is recommended that only the correct laminate be used. Inner bag was too noisy; soldiers were concerned with the noise compromising their security.
26. (Younger 1967b)	There were some problems with pouch ruptures and some punctures.
27. (Younger 1967a)	Some soldiers expressed dissatisfaction with the cans, requesting they be omitted from the pack.
28. (Younger 1966b)	Rice and sugar pouches burst in the air drop - perhaps this could be fixed with a vacuum sealed bag. The tubes of milk were also damaged and a few cans burst.
30. (Rayner ~1966)	To save weight they packed rations together in fibreboard boxes instead of tinplate boxes. This meant they crumpled slightly on air drop.
34. (Hutchinson 1962)	Briefly mentioned, all items were packed in pouches to reduce weight and volume. The troops did not evaluate this packaging.
36. (Langtry and Munro 1955)	The packaging was considered inadequate and recommendations were made for improvements.

Report	Choice
8. (Booth <i>et al.</i> 2001)	Soldiers chose the items that would make up their ration pack from a list. The list was divided into categories (main meals, vegetables, soups, dairy, fruits, sugar, biscuits, muesli bars, choc/energy bars, and beverage powders) and soldiers chose one or more from each category depending on which treatment they were assigned to. Both full and half CRP groups had high discard rates and consumed considerably less energy than they expended.
33. (Younger 1964)	They were able to choose items to make their own rations with a caloric value of 2,800, and make exchanges during the trial. Control groups were also allowed to take extra items if they desired.

Report	Temperature/Weather
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Report	Temperature/Weather
1. (Kullen <i>et al.</i> in preparation)	Ration designed for hot weather found to be more acceptable than existing ration
3. (Probert, Bandara and Jayasena 2010)	In the 2003 survey, those in cooler climates gave more favourable assessments for all items, consumed muesli bars and rated them higher, consumed fruit spreads and rated them higher. Those in hot climates stated there were insufficient snack items, and took more dried meats, canned fish and flavoured biscuits as jack rations. A slight majority (56%) gave support to the idea of a hot weather ration.
5. (Carins 2002)	Examined different climates. Those in a hot climate rated the ration lower in acceptability and consumed less. There were higher proportions of soldiers in hot climates who responded 'yes' to the question 'does the chocolate melt a lot?' and 'too many hot drinks'.
12. (Forbes-Ewan and Waters 1987)	Two groups were surveyed, one working very hard with extremes of heat (during the day) and cold (during the night); the other working moderately hard in mild temperatures. Group differences were found with respect to soup (higher preference by first group)
14. (Badcock 1985)	Hot drinks appear to be popular in hot or cold climates.
21. (Hutchinson, Reck and McLelland 1970)	Details of average weather conditions were given – 27°C and 75% humidity. The mints were recommended for removal as they were considered to be unacceptable in a hot climate.
36. (Langtry and Munro 1955)	The ration was tested in two different climates, and was deemed satisfactory for both. It was considered that more salt may be necessary for warmer climates.

Report	Speed of Eating/Meal Duration
1. (Kullen <i>et al.</i> in preparation)	No time was listed as the major reason for poor consumption of food items.
9. (Stephenson, Cavanough and Driver 1998)	Most (80%) stated that they usually have to rush their meals.

Report	Convenience
2. (McLaughlin and Hay in preparation)	Asked soldiers to nominate how they prepared some items, choosing from the options "ate directly from packaging", "removed from packaging and ate without preparation" and "removed from packaging and prepared before consuming". Most items were eaten directly from the packaging, except for the drinks (sports drink powders and coffee/tea).
3. (Probert, Bandara and Jayasena 2010)	In the 1998 survey 60% of soldiers considered there was too much waste.
4. (Carins and Thomson 2004)	A significant majority thought the weight and bulk were OK. Rubbish removal was identified as an issue for 14%.
5. (Carins 2002)	A significant majority thought the weight and bulk were OK. A common complaint was that soups take too much time to prepare. Preference was stated for pouches or freeze dried meals instead of cans.
6. (McLaughlin and Thomson 2002)	Vial matches very well received in preference to boxed matches. Retort pouches were considered a good addition instead of cans. Soups take too long to heat. Respondents were divided on the questions of 'were cans easy to carry' whereas retort pouches and freeze dried meals were both considered easy to carry by the majority. Retort pouches, freeze dried meals and cans all found to be easy to open.
7. (Forbes-Ewan 2001)	The majority (76%) were dissatisfied with the packaging – required improvements included removal of the cans. The CR1M was considered to be heavy and bulky by 87% of soldiers.

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Report	Convenience
9. (Stephenson, Cavanough and Driver 1998)	Plastic spoon breaks too easily, matches hard to light/break upon striking. Hexamine stove rated as fair. Soldiers stated that the majority of their meals were prepared by heating water and adding to the meals, but 35% said they didn't have time to heat meals. Too much reliance on readily available water. Whilst weight was not considered to be an issue, the ration was considered to be too bulky by about one quarter of respondents. Many complained about the amount of waste.
10. (Driver <i>et al.</i> 1996)	'Easy to open', 'easy to heat', 'low weight' and 'easy to dispose of after use' were considered important characteristics for the IMCR. These convenient features were not considered to be as important for the CR5M.
13. (Forbes-Ewan and Waters 1986)	Packaging was considered suitable by the majority (74%). Common suggestions for improvement were having a sealable outer bag, reducing the total packaging.
15. (Badcock and Lichtenstein 1981)	Water food bag inadequate strength, sweet wrappers stuck to sweets, matches less than ideal and the water sterilisation packaging hard to open. The packaging was considered both excessive and difficult to open.
16. (Lichtenstein 1979b)	Comments that ring top pulls on cans would be preferable. The time required to prepare items such as rice and potato and onion powder was the reason for critical responses to these items.
19. (Badcock and Lichtenstein 1978)	Reliance on water availability for FD meals was an issue. A long preparation time was also required. Bulk and weight was also considered a problem with the PRIM.
20. (Hutchinson, Gillis and Hope 1971)	A number of soldiers wanted a meal they could eat in a hurry without cooking, for breakfast or lunch. Of the participants, 94.9% thought the ration was not too heavy, and 71.8% thought that the ration did not take too long to cook. The packaging and non-edible items represent 20% of the ration weight which was considered to be an area for improvement.
22. (Dowman, McLelland and Reck 1970)	Took too much time to prepare, relied too heavily on water and there was insufficient equipment to prepare the meals. Difficult to prepare hurriedly, and cannot be broken down to suit smaller numbers. Cannot keep meals for those who come late.
23. (James and Row 1970)	Cooking time was found to be too long, longer than the preparation sheet stated. The egg blocks were difficult to break up and prepare. There was a heavy reliance on water for this ration, and many complaints about the lack of water.
24. (Younger, Spencer and Dowman 1969)	Cooking time was too long; there was a heavy reliance on water, and difficulty crushing the food blocks to prepare them.
25. (Poole 1968)	Matches were found to be unsatisfactory; easily broken when damp.
26. (Younger 1967b)	No difficulties in preparation or in carrying 7 days' worth of rations.
27. (Younger 1967a)	Soldiers complained the pack was too heavy, requesting replacement of the cans with dehydrated food. Dehydrated food was requested by 63.4% of soldiers.
28. (Younger 1966b)	The pre-cooked rice was popular due to the short preparation time.
29. (Younger 1966a)	Soldiers will discard food items to make packs lighter particularly on a long patrol which makes the caloric value lower, in this trial as usually lower than 2,500 calories per day.
32. (Smith 1964)	Some considered the ration 'a nuisance to carry'; a figure that was suspected to be artificially low as most had vehicular assistance with carrying rations.
33. (Younger 1964)	Dehydrated foods take too long to prepare. When they are tired they do not want to prepare meals as it requires too much effort.
34. (Hutchinson 1962)	Soldiers stated that they preferred rations containing pre-cooked canned meals.
35. (Hutchinson and McNaughton 1961)	The large amount of water needed to prepare the rations was considered a problem. More effort to carry the water in the ration. Time to prepare some of the meals was also considered too long.

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19. ABSTRACT Poor consumption of ration packs by Australian soldiers is common. Influences on consumption were investigated using a Three Factor Model—the food, the individual (soldier) and the environment (field). Previously collected Australian ration pack consumption data was examined under the structure of the model. Although the primary purpose for collecting the Australian data had been to determine acceptability (a food factor) variables from all three factors were observed, most commonly quality/acceptance, portion size, convenience, variety and appropriateness. Other variables were not investigated and some warrant further research. Recommendations are given for addressing some variables through ration design and other through future research.					