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Quality Assurance of Current Combat Ration Pack Components: 2009/10 Submission

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DST-Group-TR-3427

ABSTRACT

Quality assurance (QA) testing of current combat ration pack (CRP) components was carried out in support of through-life management of CRP. The QA program involved inspection and testing, interpretation of results for compliance assessment, and reporting. Many products were found to be non-compliant with Australian Defence Force (ADF) Food Specifications and/or national food standards current at the time of testing. The single most common issue was failure to meet fortification requirements. Recommendations to improve the safety and quality of CRP are provided: maintain relevant functional and performance requirements in ADF Food Specifications; ensure compliance with the requirements; and maintain a continuous improvement process for CRP components, packaging and documentation. Ongoing collaborative effort among CRP suppliers, Capability Acquisition and Sustainment Group and Defence Science and Technology Group has seen the majority, if not all, the recommendations in this report implemented.

RELEASE LIMITATION

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Quality Assurance of Current Combat Ration Pack Components: 2009/10 Ration Packing Program

Executive Summary

Quality assurance (QA) testing was carried out for 29 current combat ration pack (CRP) components from the 2009/10 ration packing program. The QA testing program consists of: determination of initial compliance and nutritional composition, shelf life evaluation, warranty verification and nutritional composition after 24 months of storage. The testing matrix for these components is provided at Appendix A of this report.

The evaluations reported here were conducted against the specifications that were current at the time of the study. This report should not be considered as wholly representative of the current state of CRP components, as many improvements have been made. However, the types of concerns raised remain relevant and worthy of vigilant monitoring to maintain and improve the quality of CRP components.

The QA program involves three main themes: inspection and testing, interpretation of results for compliance assessment, and reporting.

In this report, Defence Science and Technology (DST) Group-Scottsdale draws a number of conclusions:

- Many products in the QA testing program for 2009/10 did not adhere to Australian Defence Force Food Specifications (ADFFS) for one or more analytical determinations (chemical, microbiological, physical, and sensory), or labelling requirements
- The single most common issue was failure to comply with fortification requirements.
- In some cases, non-conformance to specification was most likely due to outdated (and inappropriate) requirements in ADFFS
- A number of non-compliances with the Food Standards Australia New Zealand (FSANZ) Food Standards Code (FSC) were identified.

Almost 20% of the components evaluated failed to meet warranty requirements. Whilst singularly, non-conformances identified would not have great impact overall, combined there is potential for substantial decrements in nutritional value and acceptability of a ration pack.

To improve the quality of CRP foods and ADFFS, it is recommended that Capability Acquisition and Sustainment Group (CASG):

• Improve and broaden functional and performance based requirements for both foodstuffs and packaging

- Investigate non-conforming product
- Remove inconsistencies and 'gaps' within the ADFFS documentation and better align documentation with national standards
- Review relevance and appropriateness of fortification requirements
- Improve initial product (sensory) quality and stability to ensure acceptance of product at time of consumption.

To improve compliance to labelling requirements, recommendations have been made to investigate inconsistencies and non-compliance of labelling to national standards. An acceptable level of deviation between analytical and Nutrition Information Panel values should also be established.

Thanks to the ongoing collaborative efforts among Health Systems Program Office at CASG, DST Group-Scottsdale, and CRP suppliers the majority, if not all, the recommendations in this report have been implemented. The non-compliant products identified in the QA 09/10 program are either no longer in CRP or have been improved by the supplier to meet the performance criteria. ADFFS have been converted to Australian Defence Standards (DEF(AUST)) and are aligned with the national standards including the FSANZ FSC. DEF(AUST) provides the functional and performance based requirements for both foodstuffs and packaging. The packaging of all CRP components has been improved based on the DEF(AUST) packaging standards.

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Acronyms

ADF	Australian Defence Force
ADFFS	Australian Defence Force Food Specifications
AQS	average quantity system
AS	Australian Standard
ASTM	American Society for Testing and Materials
ASLT	accelerated shelf life testing
BBQ	barbeque
CASG	Capability Acquisition and Sustainment Group
CFU	colony forming units
СНО	carbohydrate
CO ₂	carbon dioxide
CRP	combat ration pack
DEF(AUST)	Australian Defence Standard (used in the context of a specification identification)
DMPS	dimethylpolysiloxane
DST	Defence Science and Technology Group
FSANZ	Food Standards Australia and New Zealand
FSC	Food Standards Code
GMP	good manufacturing practice
HLTHSPO	Health Systems Program Office
IAW	in accordance with
IFST	Institute of Food Science and Technology
MAP	modified atmosphere packaging

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NATA	National Association of Testing Authorities
NEB	non-enzymatic browning
NIP	nutrition information panel
QA	quality assurance
QDA	quantitative descriptive analysis
O ₂	oxygen
RNC	recommended nutritional criteria
RPP	ration packing program
SL	shelf life
SPC	Standard Plate Count
S&T	science and technology
US	United States of America

1. Introduction

1.1 Background

The Combat Rations Fleet within the Health Systems Program Office (HLTHSPO), Capability and Sustainment Group (CASG) 'is required to deliver continuous capability through acquisition and sustainment of combat rations and ancillaries for the Australian Defence Force (ADF)' [1]. The Defence Science and Technology (DST) Group provides science and technology (S&T) support to the through-life management of combat ration pack (CRP) components, as articulated in an S&T Support Plan agreed between DST Group and CASG [1].

The S&T Support Plan included a requirement for DST Group to provide quality assurance (QA) testing for 25 current CRP components in the 2009/10 QA program. Four additional components were included as carryover from 2008/09, when only 21 components were tested, bringing the total for the 2009/10 QA program to 29 CRP components. This report details the 2009/10 QA program and provides the results and recommendations.

HLTHSPO is engaged in continual improvement activities for CRP. QA program results provide HLTHSPO with a scientific basis for changes to CRP components. Since the commencement of the QA program, there has been a progressive increase in nutritional content, quality upgrades in product formulation as well as packaging to increase shelf life (SL), inclusion of more acceptable and popular commercial brands, and contracting state-of-the-art processing facilities to ensure safety and quality of the finished products (T Quinn [HLTHSPO, CASG] 2013, pers. comm., 26 August).

1.2 Aims of this study

The QA testing program for current CRP components consists of determination of initial compliance and nutritional composition, SL evaluation, warranty¹ verification and nutritional composition after 24 months of storage. The QA testing matrix for these components is provided at Appendix A (Tables A1 and A2) of this report.

This work may be considered to consist of three main elements:

- Inspection and testing
- Interpretation
- Reporting and recommendations.

¹ Combat ration components are required to have a warranty period of 24 months when stored at 30 °C. The warranty period is not consistently expressed in relevant documentation [2, 3, 4].

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1.2.1 Inspection and testing

Testing for compliance with Australian Defence Force Food Specifications (ADFFS) [2] and other applicable standards and codes of practice, in relation to:

- 1. Chemical (mainly nutrient) composition
- 2. Microbiological quality (pathogens and spoilage microorganisms)
- 3. Physical characteristics (food and packaging)
- 4. Labelling
- 5. Nutritional quality
- 6. Sensory testing (initial results, i.e. prior to shelf-life evaluation).

1.2.2 Interpretation

Analytical results are used to determine compliance to standards and specifications for food safety, product quality, palatability, labelling and branding, SL and nutritional quality and stability. The accuracy of nutritional labelling is also assessed.

1.2.3 Reporting and recommendations

In accordance with (IAW) the S&T Support Plan:

- 1. The extent to which the components meet or do not meet the requirements is reported and recommendations made on how the deficiencies might be addressed
- 2. A report on the validity and completeness of specifications is provided with recommendations for improvements.

1.2.4 Limitations

The evaluations reported here were conducted against the specifications in place at the commencement of the study; similarly, the conclusions and recommendations are also based on the requirements in place at the time of testing. Since then there have been significant changes in the specifications, including rectification of many of the concerns raised in this report.

This report therefore provides a snapshot of the quality of a selection of CRP components at a point in time, and should not be considered as wholly representative of the current state of CRP components. Nevertheless, the types of concerns identified in this report remain relevant and constant vigilance is required to ensure quality gains are not lost and further improvements continue to be made.

Section 2.1 details assumptions about the representativeness of the samples supplied for the evaluations.

1.3 Implementation of findings

HLTHSPO, CASG has a continuous improvement program in place with its suppliers to address non-compliant and quality issues in CRP. Findings from QA programs conducted by DST Group–Scottsdale, on behalf of CASG, are addressed and resolved through a collaborative process between suppliers, CASG and DST Group.

2. Samples and Methodology

2.1 CRP items and receival inspection

A total of 29 CRP food components were planned to be assessed in the 2009/10 QA program. Table B1 in Appendix B details the components, the number of units requested by DST Group for full assessment, unit numbers delivered, product supply source, single or multiple batch supply, and the date of delivery.

The samples were assumed to be representative of the full production run for the 2009/10 ration packing program (RPP). The samples supplied to DST Group from more than one batch were assumed to have no significant batch-to-batch variation.

The number of units requested for each component was based on the need to conduct nondestructive (visual) inspections and destructive testing for chemical, microbiological, physical, initial sensory and shelf-life evaluation. Samples supplied in small serving sizes and/or with high moisture content were required in larger numbers to achieve critical mass for testing.

Potato and onion powder, initially selected for the 2009/10 QA program, was replaced with raspberry spread when the former was not procured for inclusion in the 2009/10 RPP. Typically components were received 4-6 months after manufacture. The samples were stored at ambient temperature (15-20 °C) for up to four weeks until completion of 'receival inspection'. The storage history of the samples prior to receipt at DST Group-Scottsdale was unknown, therefore no assessment has been made of the potential quality loss that may have occurred in the period between manufacture and receipt at DST Group-Scottsdale. It is assumed that the samples as received by DST Group were representative of the components as received by CASG.

2.2 Initial product compliance

2.2.1 Analytical sampling plan

A sampling plan was devised for each component for chemical, microbiological, physical and sensory analysis to ensure that the analytical samples were representative of the supplied product samples. The samples were labelled with identification numbers before undergoing further processing for analysis and/or storage trials. Five samples were removed for chemical and five for microbiological compliance testing. Another 15 samples were removed for sterility testing (where required).

For physical testing, 5–20 samples were randomly chosen, depending on the complexity of the testing undertaken. For chemical analysis in support of nutritional assessment, a

minimum² of ten individual units were combined into one sample. This was repeated to obtain duplicate samples.

Visual inspections for packaging defects and labelling compliance were conducted on 100% of samples received.

2.2.2 Microbiological, chemical and physical attributes

Chemical and microbiological testing to determine compliance with applicable specifications and standards was out-sourced to National Association of Testing Authorities (NATA) accredited laboratories. Visual inspections and physical testing of foods and packaging were undertaken by DST Group³. Table C1 of Appendix C details the methods of analysis used for chemical, microbiological and physical compliance testing. Food testing methods were based on the Official Methods of Analysis of the AOAC [5], Australian Standards (AS), British Standards and European Standard Methods. Methods for the assessment of immediate packaging are described in ADFFS Parts B, D and F [2].

Chemical analyses were conducted to:

- Measure proximates (protein, fat, carbohydrate (CHO), water, ash) and micronutrients in food
- Detect or measure the indicators of the quality of ingredients, processing and storage conditions.

Microbiological examinations were used to:

- Determine the presence/absence or the level of specific—or groups of—microorganisms, especially pathogens and spoilage micro-organisms
- Detect or measure microbial indicators of the quality of ingredients, processing and storage conditions.

Physical tests were conducted to:

- Assess the immediate packaging integrity, flaws and defects
- Determine the suitability of the immediate packaging
- Measure the food quality indicators that may change during storage.

² For small serve sizes, up to 60 sachets are required for some samples to achieve the mass needed for a complete analysis.

³ DST Group-Scottsdale is not NATA accredited for physical testing or sensory evaluation. The availability of NATA accredited laboratories for these tests is limited. In-house methods (instrumental and manual) were used for physical testing.

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2.2.3 Labelling and branding

Visual inspections were conducted to assess the labelling and branding compliance with the provisions of the Food Standards Australia and New Zealand (FSANZ) Food Standards Code (FSC), Part 1.2 – Labelling and other Information Requirements [6], with the following exceptions: Part 1.2.4 – Labelling of Ingredients, Part 1.2.10 – Characterising Ingredients and Components in Food and Part 1.2.11 – Country of Origin Requirements, were not assessed as the information necessary to assess compliance with these parts was not available to DST Group.

2.2.4 Sensory quality

Sensory evaluation was used to:

- Measure the initial product quality based on the attributes of aroma, appearance, texture and flavour
- Obtain baseline information to monitor changes over time
- Identify unpleasant odours or taints that may be present in the product due to migration of chemical compounds from the packaging or the environment.

Sensory analysis was conducted at DST Group using methods published by the American Society for Testing and Materials (ASTM) [7, 8, 9] and Standards Australia [10].

Panellists (N = 5) for all sensory evaluations were DST Group staff members. Products with Hedonic Ratings of less than 5 on a 9 point scale for each descriptive quality parameter were deemed 'unacceptable', those with ratings between 5 and 6.5 were ranked 'marginal' and those with ratings of 6.5 and above were regarded as 'acceptable'. Acceptance criteria for sensory evaluation were provided by CASG (Warrant Officer Class 1 Noel Hallett, Supply Support (Inspector Foodstuffs) Joint Logistics Command, 2001, pers. comm.).⁴

2.2.5 Nutritional assessment

Chemical analyses were performed to determine a wide range of nutrients of significance to military performance and the health of ADF members. Table C2 of Appendix C lists the methods of analysis used for determinations. The analyses were conducted to:

- Establish a baseline of nutritional content prior to storage
- Assess nutrient content at completion of warranty period

⁴ CASG and DST Group have historically used these criteria, however they have not yet been formalised. DEF(AUST) standards clarify (and effectively) replace this advice however products submitted for the 09/10 program were not required to comply with the DEF(AUST) standards.

• Assess the accuracy of nutritional information panel (NIP) claims.

All tests were performed on two composite samples.

2.3 Warranty compliance

Individual CRP food items are procured with a warranty of 24 months when stored at 30 °C.⁵ To assess compliance against this requirement, a suite of key quality measures was established for assessing product stability and SL. Consideration was given to:

- Potential safety risks and quality limiting characteristics (primary modes of deterioration)
- Storage conditions and timelines for real time and accelerated shelf life testing (ASLT)
- Sampling Plan
- Scope of inspection and testing
- Acceptance criteria for warranty
- Evaluation of analytical data.

To adequately scope potential safety risks and quality limiting characteristics guidance was sought from:

- DST Group knowledge of product ingredients and behaviour
- Chemical characteristic of the food, including moisture and nutrient content
- Microbiology of the food
- Physical structure and mechanical strength of foods and/or packaging, including break, viscosity, integrity
- Physicochemical properties of food, including water activity, colour, pH
- Package properties, including integrity, headspace pressure, volume and content.

⁵ Warranty period commences upon delivery of foodstuffs to the Commonwealth's warehouse.

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2.3.1 Storage profile

Based on the likely modes of deterioration, the storage profile detailed in Table 1⁶ was adopted for real time and ASLT.

						•	Time						
Temp			Weeks						Мо	nths			
	2	4	6	8	10	3	6	9	12	18	24	36	48
1-4°C				✓			✓		✓		✓		✓
20°C									✓		\checkmark	\checkmark	✓
30°C							\checkmark		\checkmark	\checkmark	\checkmark		
40°C						~	\checkmark	\checkmark	\checkmark				
50°C	~	~	\checkmark	\checkmark	\checkmark	~							

Table 1Storage profile for warranty verification and shelf life assessment

✓ Indicates points in the storage trial at which samples were removed for testing.

2.3.2 Sampling and testing

The sampling plan for SL assessment took into consideration:

- Sample homogeneity/heterogeneity (batch variability) to ensure samples are representative of the sample lots received by DST Group
- Sample size requirements for testing
- Number of replicates required, dependant largely on the nature (non-destructive or destructive) and complexity of each test
- Defined sampling requirements that may be applicable to specific microbiological examinations/tests
- Number of storage variables (including control samples, real time and ASLT profiles).
- Cost of samples and tests.

Table D1 in Appendix D details the sampling plan and scope of inspection and testing applied for SL assessment. Methodology used has been detailed at Table C3 in Appendix C. Nutritional assessment was scheduled for initial and endpoint assessment only. All other physical, chemical, visual and sensory inspection and testing was performed on samples drawn from storage at all profile points.

⁶ The profile runs to 48 months to enable the collection of data for the estimation of shelf life and rates of deterioration for improved understanding of the relevant processes.

2.4 Treatment of data and interpretation of results

2.4.1 Initial product compliance testing

Where appropriate, the data was characterised and interpreted using summary statistics (mean, maximum, minimum and standard deviation) and tests of significance (Student's t-test). Standard deviations were calculated using the unbiased or 'n-1' method.

Overall, with the exception of microbiological tests, the ADFFS provides little guidance on how pass/fail status is to be determined for the analytical tests when verifying the quality of CRP components. In the case of microbiological requirements, ADFFS Part A specifies the number of samples to be tested, the test criterion and the number of samples that are permitted to fail. No comparable direction has been provided in ADFFS for the interpretation of chemical, physical or sensory test data.

This deficiency has been addressed, for the purposes of this report only and where appropriate to do so, by the use of an independent, one-sample, one-sided t-test to test the null hypothesis that the population mean is equal to the specified value (the ADFFS test criterion). The t-statistic was evaluated at the 5% significance level. If the test result was found to be significantly higher or lower than the specified maximum or minimum respectively, the result was designated as a "Fail". If the test result was significantly different to, and on the 'right' side of, the test criterion, the result was designated as a "Pass". Otherwise, the result was designated as a "Pass".

Compliance was also evaluated by determining the percentage failure rate for each test. This was calculated as the number of individual data points that failed to meet the specified value or criterion, expressed as a proportion of the number of data points (replicates). In this case overall pass/fail status was not assigned; the failure rate is provided to clarify or in lieu of the t-test result.

The 'initial sensory analysis' results were produced by comparing the means of the test data against the criteria stated in section 2.2.4 above.

2.4.2 Warranty compliance testing

ADFFS does not specify performance criteria for the assessment of SL and/or warranty compliance. Therefore, evaluation of compliance was largely based on interpretation of sensory results (performance criteria defined in section 2.2.4.). Independent, one-sample, one-sided t-tests (as per Section 2.4.1) were applied using the criteria specified in Section 2.2.4 for warranty compliance.⁷

Results of quantitative descriptive analysis (QDA), physical tests and visual inspections were used as aids to explain why product quality changed during storage. Results of

 $^{^7}$ This statistical approach was only applied to sensory (9-pt Hedonic) data obtained subsequent to storage at 30 $^\circ C$ for 24 months.

visual inspections and changes (trends) in physical attributes allowed for conclusions and recommendations on product improvement to achieve warranty requirements.

Error bar charts (95% confidence interval): Summaries for Groups of Cases were created using SPSS Statistics 19⁸. The variable 'Days on Storage' was summarized within categories of 'Storage Temperature'. These charts provided a summary (snapshot) of the distribution (around the mean) of numeric variables within categories of another variable. One way analysis of variance was applied to data for each sensory and physical parameter where error bar charts indicated a likelihood of significant difference (p < 0.05) between storage profiles (sampling points). Multiple comparison tests—least significant difference – were applied post hoc to further evaluate the data.

2.4.3 Nutritional assessment

Results are reported as the means of duplicate testing. Nutrient loss over the warranty period is the difference between the initial and final values, divided by the initial value for each nutrient and expressed as a percentage. The losses are categorised as < 20%, 20-50% or > 50% loss from initial nutrient values.

⁸ SPSS Statistics 19. [Licensed material]. 2010, SPSS Inc, an IBM Company.

3. Results and Discussion

3.1 Receival inspection and testing

3.1.1 Inspection for defects

Upon receipt, all components underwent a 100% visual inspection for obvious packaging defects. Six products initially delivered to Scottsdale (direct from the manufacturer) were found to have high defect rates. These were reported to CASG⁹ and are illustrated in Figures 1 and 2. Table B2 of Appendix B details the findings of defective product. All rejected product was quarantined and disposed of upon receipt of replacement product from Prepack Ltd (the Prime Contractor).



Figure 1 Loss of packaging integrity in muesli bar packets. Note heat damage to seals and holes in top left corners



Figure 2 Defects in canned puddings; (a) major body dents, (b) food contamination (filth), (c) double seam damage and (d) body dents

Initial inspection of products supplied by Prepack (and used for the QA program) identified a number of defects. The types and quantities of defects are detailed in Table B2 of Appendix B. Packages with defects and/or in breach of other ADFFS packaging requirements were quarantined for disposal and not used for further evaluation. The exception to this was golden pudding. Prepack were not able to re-supply quarantined golden pudding samples due to stock limitations. Those packages considered to be least defective (i.e. having only cosmetic and minor defects) were used to supplement the sample to obtain critical numbers for storage trial activities (noting that samples were labelled accordingly).

⁹ Internal Defence correspondence.

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The original delivery of Worcestershire sauce sachets presented with delaminated packaging. This was reported to CASG¹⁰ and illustrated in Figures 3. Table B2 of Appendix B details the findings of the defective batch (batch code 03/02/2009). All rejected product was quarantined and disposed of upon receipt of replacement product from Prepack Ltd.



Figure 3 Delaminated Worcestershire sauce sachet

Table 2 details some of the other more substantial breaches of ADFFS requirements. A high incidence of dents in tubes was identified. The implications of this failure mode should be investigated to identify the effects and criticality (if any) on product safety and SL.

 Table 2
 Components failing ADFFS that failed to meet visual inspection upon receipt¹¹

Component	Qty	Defect
Cheese, Cheddar	21	Breach of ADFFS - Loss of Vacuum
Milk, Condensed Sweetened	288	Minor defects - Body dents
	9	Breach of ADFFS - Exterior cleanliness failures
Fruit Spread, Raspberry	575	Minor defects - Body dents

3.1.2 Non-destructive integrity testing

ADFFS did not document non-destructive methodology for determining package integrity. ADFFS requirements for package integrity were destructive by nature and DST Group identified means of evaluating package integrity that was non-destructive. This approach permitted the continued use of packages that passed the test to be used for subsequent (destructive) compliance testing. It also provided confidence that the compliance testing was not compromised by unwanted environmental exposure. DST

¹⁰ Internal Defence correspondence.

¹¹ Based on rejection limit (22) of acceptance quality level 6.5 for minor defects, from lot sizes supplied from manufacturer [11].

Group's capability permitted assessment of flexible pouches containing dry but not wet content. $^{\rm 12}$

Dry products, packaged in flexible sachets and pouches, were evaluated for fine and coarse leaks, identifying down to micro leaks that could allow moisture, oxygen (O_2) or both to compromise the safety, nutrition and/or palatability during storage. Biscuits, muesli bars, chocolate drink powder and fruit grains showed leaks in >5% of tested packets. Full details of failure rates are detailed in Table B3 of Appendix B. Figure 1 illustrates the overheated seals found on muesli bar pouches.

Failure was most likely due to one or more of the following:

- Incompatibility between sealant layer (polymer) and sealing machinery/tooling
- Overheating and/or too long a dwell time when sealing packages
- High stress forming of pouches
- Particulate matter in seals.

Appropriate matching of sealant layer (polymer) to machinery capability would likely reduce the failure rate as would adjusting pouch dimensions to provide a little slack (wriggle room) for contained product.

A strong correlation between O_2 in headspace and packaging integrity was identified during SL trials. This will be further discussed in Section 3.3.

DST Group recommends CASG consider inclusion of non-destructive integrity testing in future food specifications and standards.

3.2 Initial product compliance

DST Group has previously provided a quick response to CASG of initial product compliance to ADFFS requirements.¹³ This report is comprehensive of previous reporting and provides further guidance on possible resolutions for products of concern.

3.2.1 Chemical attributes

The full results of chemical compliance testing are at Appendix E, Tables E1 – E5. Table 3 shows the products that failed ADFFS for one or more analytical requirements.

¹² DST Group-Scottsdale has the capability to screen flexible packages filled with dry product for integrity. This technique has successfully been used to isolate packets with fine leaks prior to commencing storage trials. Since the 2009/10 evaluations, equipment for the non-destructive integrity testing of wet product has been obtained.

¹³ Internal Defence correspondence.

Component	Chemical Test/s			
Milk, dried, skim	Moisture			
Beverage, coffee, instant	Moisture; water insoluble residue			
Vegetable extract	Total solids			
BBQ sauce	Acidity and soluble solids (°Bx)			
Tomato ketchup	Titratable acidity, soluble solids			
	(°Bx)			
Fruit spread, raspberry	Soluble solids (°Bx)			
Fruit grains, apricot	Soluble solids (°Bx)			
Pepper	Ether soluble extract			
Milk, condensed sweetened	Total milk solids			
Biscuits (all variants); muesli bar (all variants);	Vitamin B ₁			
muesli cereal (all variants)				
Beverage, chocolate drink powder	Vitamin A, B ₁ , B ₂ , B ₃ , C, E			

Table 3Components failing to meet ADFFS chemical requirements (t-test, p < 0.05)</th>

Milk, dried, skim and instant coffee failed their respective specifications for moisture content. The moisture content of dried foods must be maintained at sufficiently low levels to minimise the risk of caking [12] and non-enzymatic browning (NEB) [13] which would potentially reduce SL.¹⁴ As these products – milk, dried, skim and instant coffee – have an initially high moisture content and are hygroscopic, they were monitored closely during storage trials. Section 3.3 discusses further the developments during storage. Instant coffee failed the water insoluble residue specification, compounding the risk of unsatisfactory product quality due to particulates and clumping.

The total milk solids content of milk, condensed sweetened was below the ADFFS specified value of \geq 31%. It was also below the value specified in Standard 2.5.7 (\geq 28%) of the FSC [6]. Independent of this QA activity, DST Group has provided CASG with a revised specification for milk, condensed sweetened to align with current Food Standards Australia and New Zealand (FSANZ) requirements. It remains of concern however, that the product has failed to meet the FSANZ requirement; the reasons for this should be determined and action taken to evaluate the effects and criticality of this failure on product safety and stability.

Vegetable extract marginally failed to comply with the total solids specification. The implication to quality, while considered minor, was monitored for textural changes during storage. Further discussion follows in Section 3.3.

The barbeque (BBQ) sauce and tomato ketchup failed to comply with titratable acidity and soluble solids (°Bx) requirements. These requirements work together to preserve the product from spoilage during storage. Multiple non-conformities heighten concerns for

¹⁴ Caking of dry food powders is associated with water redistribution or absorption during processing and storage. Non-enzymatic browning is a major cause of quality change and degradation in many foods and results in the loss of protein solubility, darkening and production of off-flavours. Factors such as temperature, water activity and pH influence non-enzymatic browning.

premature product failure during storage. A consistent and more stringent control over compliance requirements for all sauces (scoping moisture, water activity, pH, titratable acidity and total soluble solids) should be considered in future reviews of product specifications.

Fruit spread, raspberry was found to be non-compliant for soluble solids, thereby increasing the risk of yeast and mould growth within the product. Independent of this QA program, fruit spread was also identified as non-compliant with the FSC requirement for sorbate as it contained approximately 650 mg/kg sorbate when tested. Sorbate is not a permitted additive to fruit and vegetable spreads unless it is a low joule product [6]. The fruit spread is not a low joule product.

The soluble solids results for fruit grains (other than apricot) were inconclusive due to difficulties in conducting the analysis on an opaque and solid material¹⁵. It is likely that the specification was intended for use during manufacture but this intent was not clearly stated therefore the application to the finished product may be erroneous.

The failures detailed in Table 3 should be investigated and the adequacy and practicality of the specifications should be reviewed. Further development of CRP component specifications is needed to set appropriate and achievable functional and performance criteria for food safety and quality measures.

CASG advised that no CRP components were fortified for the 09/10 RPP even though this is was an ADFFS requirement for several products.¹⁶ Given this, DST Group did not conduct vitamin analysis to verify ADFFS fortification requirements.¹⁷ Instead, failures against the specification have been recorded based on this advice.

NATA accredited laboratories could not be located to determine the cocoa content of Chocolate Drink and the dimethylpolysiloxane (DMPS) content of Instant Coffee. Therefore these analyses were not conducted. Compliance with these requirements could be checked by audit rather than analytical testing. It is a FSANZ requirement (FSC, Part 1.2.4) that this anti-caking and anti-foaming agent (additive number 900a) be declared on labelling if present. As the presence of the additive was not declared in the products of interest, it may not have been used and may not be needed.

Future reviews of product specifications should consider the relevance and need for specified requirements for which there is not a clear need in terms of performance. For example, there may no longer be a need to specify the DMPS content of instant coffee nor the ether and alcohol soluble extracts of black pepper.

¹⁵ Analysis contracted out to a commercial laboratory.

¹⁶ Vegetable extract, as a commercial product, is fortified.

¹⁷ Sampling and testing was not conducted on products with a fortificant requirement. However, sampling and testing, as per the nutritional quality assessment was conducted and provided some insight into compliance. Refer Section 3.6 for further discussion.

3.2.2 Microbiological attributes

The full results of microbiological compliance testing are in Tables F1-F4 at Appendix F. Sweet chilli sauce failed the ADFFS standard plate count (SPC) requirement of <20 colony forming units (CFU)/g. Whilst higher than specified by ADFFS the sweet chilli sauce SPC was still within the good manufacturing practice (GMP) level (<103 CFU/g) specified by the Institute of Food Science and Technology (IFST) [14]. BBQ sauce currently has an SPC specification of <104 CFU/g and limits have not been set for Tomato Ketchup and Worcestershire Sauce. The SPC specification for all sauces should be reviewed and consideration given to setting limits that are more in line with GMP, or slightly tighter as military use may justify more stringent requirements.

The results were inconclusive for Yeasts and Moulds in BBQ sauce, tomato ketchup and sweet chilli sauces (mould only). The testing laboratory did not report the results with the required sensitivity to determine whether the minimum criterion was met—that not more than one sample has greater than 50, 1 and 10 CFU/g respectively. The sensitivity of the method as performed was <100 CFU/g. Implementation of IFST guidance (<100 CFU/g mould and <100 CFU/g yeasts) for all sauces would remove confusion surrounding reasons for varying levels.

Failure of sauces to comply with acidity and soluble solids content (Refer Section 3.2.1) is likely to compound issues relating to quality and safety of these products. The effect and criticality of both microbiological and chemical attribute failure to comply with requirements is warranted.

In addition to that required by current ADFFS, CASG requested that DST Group evaluate SPC and yeasts and moulds for all remaining products in the 09/10 QA program. Using IFST guidance for GMP [14], crispbread biscuit returned high counts in 3 of the 5 samples and muesli, cereal, natural returned 2 of 5 counts higher than recommended for SPC (Table F1 of Appendix F).

3.2.3 Physical attributes

3.2.3.1 Food

The full results of physical compliance testing of food items are in Tables G1 – G3 at Appendix G. Table 4 shows the products that failed ADFFS specifications for one or more physical requirements.

Fruitful muesli, BBQ sauce and Worcestershire sauce failed to comply with ADFFS for net weight. It is recommended that HLTHSPO CASG investigate why net weight failures have occurred to determine if the specification is in need of revision to reflect a more appropriate quantity (with tolerances) or whether these components are simply not being packaged in adequate amounts? The average quantity system (AQS) [15] is more aligned

with manufacturing practices today. DST Group recommend compliance with AQS be mandated in ADFFS and manufacturers/packers required to comply accordingly.

Table 4Components that failed to meet ADFFS physical requirements for foodstuffs

Component	Physical test/s		
Fruitful muesli; BBQ sauce	Net weight		
Fruit grains (all flavours)	Water activity		
Fruit grains (except raspberry)	Physical size/dimensions		
Sweet chilli sauce; tomato ketchup	pH		
Worcestershire sauce	Net weight and particulate residue		

The water activity of the fruit grains was below the specified value (≥ 0.5). While this result may be favourable in terms of protecting the product from microbiological growth, it may lead to loss of textural quality. The water activity was monitored during SL assessment to assess textural changes and this is discussed further in Section 3.3.

The fruit grains failed the ADFFS with regard to physical dimensions (size) of individual grains. Grains were not consistent in form/shape (Figure 4) and not as specified. The effect and criticality of this failure should be investigated. If criticality is found to be negligible, that is, it is a cosmetic/appearance related criteria, the requirement may be over-specified. The Worcestershire sauce failed the ADFFS for particulate residue. Again, if the effect and criticality of this failure does not affect the quality and safety of the product a less stringent specification may be warranted.



Figure 4 Fruit grains were of inconsistent size and shape (scale is in cm, 1 mm divisions). The fruit grains (apricot) in this image were from a single packet

Currently, there are pH specifications for BBQ, sweet chilli sauce and tomato ketchup, but not for Worcestershire sauce. A pH specification should be set for Worcestershire sauce. The United States of America (US) Food and Drug Administration value of 3.63 – 4.00 [16] may prove appropriate. It is not surprising that pH failures have occurred as Section 3.2.1 has already reported compliance failure to acidity requirements. Sauces have multiple non-compliances to specifications. Investigation of the failure mode, effect and criticality analysis is strongly recommended to ensure the product remains safe and palatable until the point of consumption.

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Bostwick analysis was not conducted on sauces, as methodology was not available within ADFFS or Australian Defence Standards (DEF(AUST)). Additionally the product specification did not provide sufficient detail to establish test methodology. DST Group recommends CASG initiate a review of ADFFS Part D: Chemical Methods, published within the ADFFS [2] to review its content and up-date where appropriate.

While there is no ADFFS requirement for headspace in puddings, a large product to product and between package variability warrants discussion. Differences were also identified between centre and side of cans for all three puddings. Variability has the potential to negatively influence the product stability during storage. There is a need to both restrict and make consistent the headspace within cans and between cans. A criterion of ≤ 10 mm (over the entire surface area) has been proposed by DST Group. With this criterion in mind, a significant quantity of cans failed to meet this criterion (Appendix G, Table G3). DST Group recommends CASG investigate ways to ensure that variability between cans is reduced and a suitable criterion for headspace is established.

3.2.3.2 Packaging

Full results of physical compliance testing of packaging are in Tables H1 – H4 at Appendix H. Table 5 shows the products that failed ADFFS for one or more packaging requirements.

Component	Physical property
Fruit grains (all variants); sweet chilli sauce; tomato ketchup; pepper, black	Package dimensions
Biscuits, cream cracker; biscuits, plain, sweet; biscuits, butter; fruitful muesli; natural muesli; chocolate drink powder; coffee, instant; sweet chilli sauce; BBQ sauce; tomato ketchup	Seal width
Biscuits (all variants); muesli bars (all variants); muesli, cereal, natural; beverage, chocolate drink powder	Presence of tear notch
Milk, dried, skim; beverage, coffee, instant; sauces (all variants)	Placement of tear notch
Milk, condensed sweetened	Thread diameter

Package dimensions have a direct effect on its barrier properties. Increases in surface area result in increased total mass transfer of water and/or O_2 , hence the need to regulate overall packaging dimensions and monitor compliance. Total surface area should be considered when assessing potential CRP components. It is recommended that specifications be developed for package dimensions (with tolerances) for all CRP components.

ADFFS 15-5-1 Flexible Packaging Materials and Pouches for Foodstuffs [2] specifies the seal width of pouches fabricated from flexible packaging materials shall not be less than:

- a. 5 mm at any point for any seal up to and including 80 mm in length; and
- b. 8 mm at any point for any seal over 80 mm in length.

Without regard for presence of tear notches, several products failed to comply (Table 5). The presence of tear notches reduces the effective seal width and of those with a tear notch present (Refer Appendix H, Table H2) resulted in milk, dried, skim and Worcestershire sauce also falling short of seal width requirements.

Sauces, pepper, black and beverage, coffee, instant were the only products compliant with ADFFS 15-5-1 requirement: all flexible pouches be notched on two sides. Others contained a notch on one side only. Packages where a seal is affected by a serrated edge may negate the requirement for a tear notch. This will be dependent on the polymers and extrusion processes used to produce the layers of the laminate.

Independent to this QA programs, a review of the immediate packaging specifications is being conducted to ensure requirements are necessary, concise, unambiguous and complete. This will address some of the questionable requirements that are currently specified. Refinement of the following is expected as part of this review process:

- Packaging dimensions (including tolerances)
- Presence and placement of tear notches in flexible packages (where appropriate)
- Design/construction of tubes
- Performance requirements for seal width and seal strength.

Manufacturers and suppliers should be made aware of the upcoming changes to packaging specifications, paying particular attention to the need for minimum seal width requirements. Many items currently supplied in flexible packaging do not meet the proposed specification. Notably, biscuits, sauces and muesli products are of immediate concern.

Muesli mixes are required to be gas flushed when packing, in order to reduce the O_2 in headspace and prolong SL. Analytical data supports this activity as having been conducted. Results of headspace O_2 are however variable (Table H4 of Appendix H), indicating that these modified conditions have been quickly lost. Headspace analysis of like products having both passed and failed initial packaging integrity testing identified significant differences in the headspace content. Packages retaining integrity possessed reduced O_2 levels compared with packages of poor integrity, these having atmospheric conditions (as readily equilibrated through localised areas of leakage.

ADFFS does not specify modified atmosphere packaging (MAP) conditions for any other O_2 -sensitive products. SL trials monitored the O_2 content in biscuits, muesli bars, muesli mixes, beverages, fruit grains and pepper, black. Results of this are discussed in Section 3.3. These products were anticipated to absorb (consume) O_2 during storage.

DST Group recommend CASG investigate ways to ensure that absorption of O_2 is minimised through removing (reducing) the O_2 available.

3.2.4 Labelling and branding

The full results of labelling compliance are at Appendix I (tables I1–I3). Chocolate drink powder failed to comply with Part 1.2.2, Clause 3 of the FSC [6] by not identifying the business address (Refer Table I1 of Appendix I). DST Group recommends this non-compliance be resolved. DST Group also recommend consideration be given to introducing a requirement for "How to prepare" milk powder, skim.

3.2.4.1 Mandatory Warning and Advisory Statements and Declarations

As per the requirements of Standard 1.2.3 of the FSC, all products were found compliant with labelling requirements for:

- Mandatory advisory statements and declarations
- Mandatory warning statements
- Advisory statements in relation to foods containing polyols or polydextrose.¹⁸

A number of omissions to 'declarations of certain substances in foods' requirements were identified. Refer Table I2 of Appendix I for details of moot ingredients listings and Table I.2 for full results of compliance evaluation. On the basis of information provided in ingredient listings on product packaging, the following declarations appear to be missing:

- Natural muesli Declaration that product contains cereals (containing gluten) and sulphites was required.
- Pudding, fruit Declaration that product contains cereals (containing gluten), eggs, milk and sulphite was required.
- Pudding, chocolate and pudding, golden Declaration that product contains cereals (containing gluten), eggs and milk was required.

Ingredient listings for fruit grains (raspberry and mixed berry variants) and tomato ketchup also made use of the European Union approved additive 'E' numbers and not those of Standard 1.2.4 of FSC Schedules [6]. Details of ingredient listings can be found in Table I1 of Appendix I. This has the potential to cause confusion and could easily be rectified by removal of 'E' numbers and replacing them with those approved by FSANZ.

¹⁸ For details refer to Standard 1.2.3 of the Food Standards Code [6].

3.2.4.2 Nutrition information requirements

All products were found compliant with NIP for 'per serving' nutrient details. Only fifteen products (biscuits, muesli bars, muesli mixes, cheddar cheese, puddings and fruit grains (apricot and tropical variants)) were compliant with inclusion of NIP detail 'per 100 g' of product (Refer Table I3 of Appendix I). Coffee and pepper, black were exempt from NIP requirements. The high failure rate for this requirement warrants investigation. Whilst FSANZ currently offers exemption to small packaging (surface area 100 cm2) to carry all labelling requirements as per FSC. The inclusion of NIP panels on all CRP components including small packages provides consumers with a sound basis for informed food choices.

3.2.5 Initial sensory quality

Muesli mixes and milk, dried, skim were evaluated for attributes on their (packaged) dry and ready to eat content, all other products were evaluated as received. Full results of initial sensory analysis are in Table J1 of Appendix J. No product was rated as "not compliant" or "marginal". There were however a number of concerns identified and these have been detailed in Table 6. Each of the identified products was found to have two or more sensory attributes (aroma, appearance, texture and/or flavour) with mean values below the criteria applied. Overall acceptability was anticipated to be directly influenced by these quality attributes.

Table 6 Pr	oduct at risk of a	not meeting overall	acceptability cr	riteria (9-point he	donic scale rating)
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Product	Attribute	
Forest fruits, muesli bar	Aroma, appearance, texture and flavour	
Beverage, chocolate drink powder	Aroma and appearance	
Beverage, coffee, instant	Aroma, texture and flavour	
Sauce, BBQ	Aroma and flavour	
Sauce, sweet chilli	Aroma and flavour	

With little flexibility to allow for product deterioration during storage, products listed in Table 6 were considered to be at high risk of not meeting warranty requirements. Close attention should be paid to the ratings of these products during storage, as a small decrease in one or more quality attributes may result in the product becoming 'unacceptable' and thus failing to meet the required SL.

DEF(AUST) individual product specifications have made headway toward standardising and formalising minimum performance criteria for sensory quality of CRP food items, Performance criteria for initial and warranty sensory attributes is anticipated to allow (on the whole) for potential quality losses during storage, while still delivering an acceptable, palatable product at the time of consumption. The criteria defined in Section 2.2.4. are reasonable as a blanket approach for defining sensory quality until more is known of the stability of individual food items. At that time, varying performance

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criteria may be set for initial quality, with the underlying target that regardless of the product or its rate of deterioration, all food items will meet minimum performance criteria on completion of storage for the warranty period.

Crystallisation was noted in sweetened condensed milk during sensory evaluation (Figure 5). It was strongly suspected that these were lactose crystals. The presence of lactose crystals of greater than 80 µm in diameter will adversely affect textural quality. Currently ADFFS does not specify requirements for crystal size and/or quantity. Consideration should be given to inclusion of such. The Australian Dairy Goods value of 'not less than 400,000/mL' could be used as guidance [17].



Figure 5 Phase/ structure of sweetened condensed milk (a) Tube end with liquid and crystalline condensed milk, (b) Magnified crystals from tube (crystals ~125 µm in diameter)

3.3 Warranty compliance

Evaluation and interpretation of compliance to the warranty requirement was largely based on the results following storage at 30 °C. Table K1 of Appendix K details results of sensory evaluation subsequent to storage for 24 months at 30 °C. Figures K1-K8 at Appendix K provides a graphical representation of the sensory stability of products following 6, 12, 18 and 24 months storage at 30 °C.

Biscuits, muesli bars, muesli mixes and to a lesser degree coffee and fruit grains all returned large variability in data (for singular profile replicates) for the O_2 in headspace throughout storage trial evaluations. This hindered the statistical power of establishing correlations between, sensory (rancidity) and O_2 content in the headspace surrounding product.

3.3.1 Biscuits, commercial

Individual biscuit packages were screened for packaging integrity prior to the commencement of the storage trial and only packages free of fine and coarse leaks were

placed on storage. There was no guarantee that package integrity would remain intact throughout the storage trial as seal deterioration and leaks could occur.

Figure K1 of Appendix K illustrates the changes in product acceptability during storage at 30 °C. Sensory results for the aroma and flavour attributes decreased over time for all biscuit variants stored at 30 °C. All products were rated as 'unacceptable' for aroma and flavour after 24 months. Crispbread biscuits were found "unacceptable" for aroma after 6 months while the flavour remained acceptable until the 24 month evaluation. Significant decline in headspace O_2 levels was evident for all biscuit variants and results correlate with the development of rancid notes (in aroma and/or flavour) and aftertastes, ultimately giving rise to an unacceptable product following 24 months storage. The level of significance is reported below for each biscuit variant.

Appearance and texture remained largely unchanged and effects of storage on these attributes were seldom evident above the sample to sample variation inherent in these products.

Biscuits were found not compliant with warranty requirement. Onset of rancidity was the major contributor to this failure. CASG should investigate the potential use and application of modified atmospheres to package biscuits. Industry commonly gas flush product prior to sealing or insertion of O_2 scavenger, to remove O_2 in headspace. A more innovative approach would be to employ active packaging by using packaging materials with embedded O_2 scavengers.

The US military make wide use of gas flushing and O_2 scavengers for many of their O_2 -sensitive ration components. Table 7 details techniques employed for O_2 -sensitive products¹⁹. The specifications laid down by the US military for biscuits/crackers and noodles are appropriate for the ADF to adopt as specifications for their equivalents. Ultimately, the amount of O_2 available in the headspace must be kept below threshold levels at which quality losses will occur. Coffee degradation can occur with the uptake of as little as 5 ppm O_2 , while dry foods (in general) will likely show quality loss with an uptake of 15 ppm [18]. The use of high barrier films and MAP will limit the amount of O_2 in the headspace surrounding products and limit the quality losses currently observed when the product is stored for long periods of time.

The chemistry that dictates the rate and level of oxidation within packaged food is complex and varies between CRP components.

¹⁹ This information was current as of July 2004.

Ration item	Packaging Structure	Treatment	O ₂ content (%)
Cookies (shortbread, choc coated oatmeal, brownies)		Vacuum packed	Negligible
Crackers	50 μm ionomer or	O ₂ scavenger	< 0.3
Wheat snack bread (2)	polyethylene/		
Pound cake, fudge brownie	9 μm aluminium foil/		
Chow mein noodles	12 µm polyester		
Snack foods (pretzels/potato sticks)			
Nut raisin mix	76 μm ionomer or polyethylene /	O ₂ scavenger or	< 2.0
		N ₂ flush	
	9 μm aluminium foil/		
	23 µm oriented polypropylene		

 Table 7
 Current use of MAP and scavengers in US Military ration components

It is clear that the SL of the O₂-sensitive products identified in this report would be prolonged by the use of MAP techniques. Products that currently exhibit detectable levels of rancidity during storage should be formulated with or packaged with an O₂ scavenger and/or a high O₂ barrier laminate. Manufacturers of O₂ scavenger sachets recommend the use of laminates with an O₂ transmission rate of no greater than 15 cc O₂/m².day when scavenger sachets are used. This is sufficient to protect the sachet from premature expiration during storage. Such products should include muesli bars, biscuits and noodles. Other O₂-sensitive products should at a minimum be packed under nitrogen to maximise product quality throughout storage.

Options for reformulation should also be investigated to improve product quality and stability, reducing the likelihood of rancidity and unpleasant aftertastes developing.

3.3.1.1 Cream cracker

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma and flavour following 24 months at 30 °C (Table K1 and Figure K1(e) of Appendix K). Flavour was significantly different from both initial quality response and warranty requirement (p<0.001). QDA identified significant decline (p<0.001) in freshness (aroma and flavour) and increased rancidity following storage at 30 °C for 24 months.

No discernible changes in product texture were observed in either sensory or instrumental measures. Net weight remained constant. The water activity fluctuated between 0.2 and 0.4 during storage. Given that no discernible change in net weight was observed, moisture
migration remained within the packaged environment. Significant increase in water activity was observed in product stored for 10 weeks at 1 °C, 12 months at 20 °C and 18 months at 30 °C (p<0.001). Movement of bound moisture to free moisture may be revealed by what was previously understood to be fat migration (as illustrated in Figure 6).



Figure 6 Surface of cream cracker biscuit after 12 months storage at 20 ℃. Note speckled appearance indicating fat migration

A high incident rate of product breakage was observed throughout storage trials, irrespective of temperature and time exposure. Cream cracker, by its nature, is susceptible to mechanical and physical abuse, especially shock and vibration. Given these hazards are frequently encountered by CRP, the ongoing prevalence of product breakage will continue.

A significant reduction in O_2 content of headspace was observed following 12 months at 20 °C, 6 months at 30 °C, 6 months at 40 °C and 2 weeks at 50 °C (p<0.001). This decline continued over the duration of the storage trials and was aligned with the onset of rancidity, and its subsequent increased intensity. Storage at 50 °C produced discernible levels of carbon dioxide (CO₂). DST Group surmise, this is a result of liberation from sodium bicarbonate, a raising ingredient [500] in cream crackers. Oxygen levels were depleted (to below 1%) on conclusion of storage at 20 and 30 °C.

3.3.1.2 Plain, sweet

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma and flavour following 24 months at 30 °C (Table K1 and Figure K1(e) of Appendix K). Flavour was significantly different from both initial quality response and warranty requirement (p<0.001). Aroma was also significantly different (p<0.001) from initial quality at completion of warranty. QDA identified discernible loss of buttery attribute and increased in rancidity (flavour) following storage at elevated temperatures.

Changes in product texture (sensory and instrumental) were minor. An increasing trend in the deformation measure was observed in samples stored at 1, 20, 30 and 40 °C, indicating the product may become more pliable during storage. Significant change in deformation was observed after 6 months at 30 °C (p<0.001). The water activity fluctuated between 0.3 and 0.4 during storage however, given no discernible change in net weight; moisture migration/movement remained within the packaged environment. While a significant

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increase in water activity was observed in product stored for 2 years at 20 °C (p<0.01) and declined following 12 months at 40 °C (p<0.02), no significant movement was observed when stored at 30 °C.

A significant reduction in O_2 content of headspace was observed following 24 months at 20 °C, 12 months at 30 °C, 9 months at 40 °C and 6 weeks at 50 °C (p<0.001). This decline continued over the duration of the storage trials and was aligned with the onset of rancidity and its increasing intensity. Oxygen levels were depleted (fell below 1%) on conclusion of storage at 30 °C. Storage at 50 °C produced discernible levels of CO_2 .

3.3.1.3 Butter

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma and flavour following 24 months at 30 °C (Table K1 and Figure K1(e) of Appendix K). Flavour was significantly different from both initial quality response and warranty requirement (p<0.001). QDA identified discernible decrease in buttery flavour and increase in taints, rancidity (aroma and flavour) and aftertaste when product was stored at 30 and 40 °C.

Changes in product appearance and texture (sensory and instrumental) were minor. Overall texture ratings did suggest that acceptance of the texture diminished during storage however not to the point of product failure. The water activity fluctuated between 0.25 and 0.35 during storage however given, net weight remained constant, moisture migration, if any, remained within the packaged environment. While significant increase in water activity was observed in product stored for 2 years at 20 °C (p<0.001) and declined following 9 months at 40 °C (p<0.001), no discernible trend was observed when stored at 30 °C.

A significant reduction in O_2 content of headspace was observed following 12 months at 20 °C, 6 months at 30 °C, 6 months at 40 °C and 4 weeks at 50 °C (p<0.001). This decline continued over the duration of the storage trial and was aligned with the onset of rancidity and its increasing intensity. Storage at 50 °C also produced discernible levels of CO_2 . Oxygen levels dropped to below 10% on conclusion of storage 30 and 40 °C.

3.3.1.4 Crispbread

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma and flavour following 24 months at 30 °C²⁰ ((Table K1 and Figure K1(e) of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma and flavour (p<0.003 and p<0.001 respectively). QDA identified significant levels of rancidity product (aroma and flavour) stored for 2 years at 30 °C (p<0.03).

No discernible changes in product appearance and texture were observed in either sensory or instrumental measures. Net weight remained constant. The water activity fluctuated

 $^{^{20}}$ Aroma failed to comply with require after only 6 months of storage at 30 °C.

between 0.2 and 0.4 during storage however given, no discernible change in net weight was observed, moisture migration remained within the packaged environment. While significant increase in water activity was observed in product stored for 2 years at 20 °C (p<0.001) and declined following 6 months at 40 °C (p<0.001), no discernible trend was observed when stored at 30 °C. Movement of bound moisture to free moisture was the likely cause of this.

A significant reduction in O_2 content of headspace was observed following 24 months at 20 °C, 6 months at 30 °C, 6 months at 40 °C and 6 weeks at 50 °C (p<0.001). This decline continued over the duration of the storage trials and was aligned with the onset of rancidity and its increasing intensity. Oxygen levels were depleted to below 5% on conclusion of storage at 30 °C. Discernible levels of CO_2 were produced during storage at elevated temperatures.

3.3.2 Muesli bars

In order to gain critical mass for storage trials, DST Group have included up to 5% of the muesli bar samples previously failing the initial packaging integrity testing. Concerns raised herein with respect to warranty compliance were likely heightened by poor packaging integrity.

Headspace analysis of packets clearly illustrated the influence of initial packet integrity on the outcome of storage trials. The majority of packages observed indicated decreasing O_2 levels; a small number however had atmospheric levels of O_2 , indicating that through lack of integrity, ingress of atmospheric O_2 prevailed. This outcome was irrespective of time or temperature.

Both the forest fruits and apricot and coconut muesli bars failed to comply with warranty requirement.

The onset of NEB, as evident by colour change and movement of moisture, largely influenced product failure. The onset of NEB directly influenced aroma, appearance and flavour ratings. Textural changes due to moisture migration were also evident.

Reformulation and/or the use of alternative processing techniques should be investigated to reduce influence of NEB on product quality. In addition, CASG should liaise with manufacturers/suppliers to improve the seal integrity of packets.

3.3.2.1 *Apricot and coconut*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma, appearance, texture and flavour following 24 months at 30 $^{\circ}C^{21}$ (Table K1 and Figure K1(e) of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma, texture and flavour

²¹ Texture failed to comply with requirement after 18 months of storage at 30 °C.

(p<0.003). QDA identified a decline in moisture content (changes in moistness, chewiness and hardness attributes). This aligned well with the increased break force (instrumental) measures, particularly with increased exposure to elevated temperature (30 and 40 °C).

QDA also identified development of an aftertaste when stored at 30, 40 and 50 °C.

Changes in product appearance were evident from both sensory and instrumental colour measures. QDA identified a decline in product colour from golden to dark brown and a loss of gloss during storage. Instrumental colour (L, a* and Y-brightness scales) also indicated product darkening with significant changes evident after 24 months at 30 °C (p<0.001). This was intensified by high temperature exposure. No discernible changes in headspace O₂ or net weight were observed. The water activity trended downward (from 0.6 to 0.5). A significant decline were observed following storage for 12 months at 40 °C (p<0.05). Given no discernible change in net weight was observed, moisture migration remained within the packaged environment.

This product failed to comply with warranty requirement.

3.3.2.2 Forest fruits

Forest fruits muesli bar was previously found to be of 'marginal' acceptability for 3 of 4 attributes [14]. Subsequent to this, the mean values for aroma, appearance, texture and flavour fell below the cut-off value of 5 on the 9-pt Hedonic scale following 24 months at 30 °C (Figure K1(e) of Appendix K). Flavour was found significantly different from both initial quality response p<0.002) and warranty requirement.

Changes in product appearance were evident from both sensory and instrumental colour measures. QDA identified a decline in product colour from golden to dark brown during storage. Discernible changes in instrumental colour measurements were evident throughout storage at elevated temperatures – more evident on the a* and b* colour scales. Figure 7 provides a visual representation of initial and final product appearance.



Figure 7 Forest fruits muesli bar; (a) Initial quality and product stored (b) 24 months at 1 °C, (c) 24 months at 20 °C and (d) 24 months at 30 °C

No discernible changes in net weight were observed. A significant decline in water activity was observed following storage for 6 months at 30 °C and 3 months at 40 °C (p<0.001). Water activity dropped to 0.5 on completion of warranty requirement. Given no discernible change in net weight, moisture migration/movement remained within the packaged environment.

Textural measures identified significant changes as the product hardened with exposure to time and temperature. QDA hardness ratings were significantly higher after 18 months at 30 °C (p<0.002). Instrumental measurement of break force at end of warranty was significantly higher (p<0.001) also.

This product failed to comply with warranty requirement.

Onset of rancidity also has the potential to limit SL of this product. Rancid notes were detected in product stored at 20 and 30 °C and aligned with decreased levels of O_2 in packet headspace. A significant decline of headspace O2 was observed on conclusion of warranty storage (p<0.01).

3.3.2.3 Tropical

Tropical muesli bar was compliant with sensory quality requirements for warranty (Figure K1(e) of Appendix K). QDA did identify notable changes to appearance and texture. QDA identified a drying out of the product, with ratings for moistness, chewiness and hardness attributes declining. A significant change (p<0.002) in hardness was evident after 24 months at 30 °C.

Changes in product appearance were evident from both sensory and instrumental colour measures. QDA identified a decline in product colour from golden to dark brown during storage. Instrumental colour (L, a* and Y-brightness scales) also indicated product darkening. This was intensified by high temperature exposure. No discernible changes in net weight were observed. The water activity trended downward (from 0.6 to 0.5). A significant decline were observed following storage for 24 months at 30 °C, 3 months at 40 °C and (p<0.001). Given no discernible change in net weight was observed, moisture migration/movement remained within the packaged environment.

Onset of rancidity also had the potential to limit SL of this product. Headspace O_2 decreased during storage, becoming significant after 18 months at 30 °C. On conclusion of warranty storage, levels dropped to below 5%.

This product met the warranty requirement.

3.3.3 Muesli mixes

Sensory evaluations of muesli mix were conducted on both dry and wet samples. Skim Milk prepared from powder (1:10 Ratio) was provided to panellists.

Muesli mixes were packed under modified atmosphere (gas flushing) to reduce the O_2 content in the headspace. It is not known to DST Group the O_2 levels that were achieved at packaging. Shortly after receipt of samples by DST Group, levels of between 4 and 21% were recorded. Results were clearly bi-modal. Those with packaging integrity were well below atmospheric conditions for O_2 where as those with loss of integrity closely resembled atmospheric conditions.

This bi-modal distribution (of packaging integrity and its subsequent effect on presence of O_2 as a deteriorative factor) prevented accurate interpretation of warranty compliance and SL.²² Another bi-modal distribution factor was the variable post storage headspace volume. Many packets appeared to have little (or no) headspace volume (as illustrated by Figure 8 a, b and d) while others retained a headspace (as illustrated by Figure 8c). There was no evident correlation of headspace volume to time or temperature as the influencing factor of this result but rather the occurrence appeared related to the packaging integrity.



Figure 8 Typical appearance of muesli mix packets post storage (24 months)

The storage trials conducted by DST Group were not designed to evaluate this packaging concern and as such data was not collected (on a packet-by-packet event) to permit an accurate evaluation and correlation between initial headspace content, or the trends in headspace content and volume as affected by packaging integrity, time, temperature and product reactivity in time. DST Group recommend CASG investigate the precision and repeatability of manufacturer's initial gas flushing activities and subsequently monitor the packaging integrity, headspace content (namely O_2) and volume to understand which factor/s directly influence the SL of this product.

Inadequate water barrier properties were also indicated by the significant (p < 0.005) movement in water activity of samples stored at 1 °C over time. Here, storage facilitated inward migration of moisture, given the high humidity of the storage room. Samples stored at 40 and 50 °C experienced significant²³ declines in water activity with time. Moisture analysis conducted for nutritional content (initial and end of warranty) induct substantial decline in moisture content; fruitful muesli mix dropped from 5.3% to 4.1% while the natural muesli mix dropped from 10.8% to 7.7% These results indicate that the current packaging is not a good barrier to moisture migration.

3.3.3.1 Fruitful breakfast

Fruitful breakfast was compliant with sensory quality requirements for warranty (Figure K2(e) of Appendix K). However the dry product did decline considerably in both appearance and flavour whilst aroma, texture and flavour of the prepared product (as

 $^{^{22}}$ Large packet to packet variability was observed in headspace O_2 concentration and headspace volume. As such the product flavour varied between packets. Variability in package integrity was thought to have been the key factor influencing the packet-to-packet variability.

 $^{^{23}}$ P values ranged from < 0.000 to < 0.05.

intended for consumption) did not substantially decline.²⁴ QDA did not identify any discernible changes throughout SL evaluations.

No discernible changes in net weight, colour, water activity or headspace composition were observed. The water activity trended upward under low temperature and high humidity storage conditions.

While the data collected (average of samples tested) suggests this product met the warranty requirement, large packet-to-packet variability would indicate a proportion of the product supplied to CASG is unlikely to be compliant with warranty and SL requirements. We have concerns over the reliability of packaging integrity and its effect on product quality given potential for ingress and egress of moisture and O_2 .

3.3.3.2 Natural

Natural muesli was compliant with sensory quality requirements for warranty (Figure K2 (e) of Appendix K). However, the dry product had a substantial decline in flavour, additionally decline was observed in texture and flavour (p<0.002)²⁵ after preparation (for consumption). QDA did not identify any discernible changes throughout SL evaluations.

No significant changes in sensory or instrumental measures of colour were discernible after two years at 30 °C. QDA identified a decline in product colour from golden to dark brown during storage at elevated temperatures (40 °C). Similarly, the instrumental colour measurements identified change at elevated temperatures – more evident on the, a* and b* colour scales.

No discernible changes in net weight or headspace gas content were observed. A significant decline in water activity was observed following storage for 24 months at 30 °C and 12 months at 40 °C (p<0.001). Water activity dropped to 0.5 on completion of storage under the warranty conditions.

As with the fruitful breakfast muesli, this product has met the warranty requirement. Again we have concerns over the reliability of packaging and the compliance of the product batch supplied to CASG.

3.3.4 Dairy products

As evident by colour change, NEB was the primary mode of deterioration. Significant change in visual and instrumental measures of colour was observed well short of warranty requirements.

Preventing the onset and rate of NEB is crucial to maintaining product stability during storage. The dairy products evaluated illustrated varying degrees of NEB. The

²⁴ Appearance was not evaluated on the prepared product.

²⁵ Appearance was not evaluated on the prepared product.

intermediate moisture foods were of greatest concern, while the dried product only exhibited quality change at extreme (50 °C) temperatures. Novel and innovative processes and/or optimised formulations should be investigated as a means to prevent, if not minimise, the effects of NEB. CASG should consult with the manufacturer/supplier to gain further insight into means of achieving product stability and to identify options for improving product quality.

3.3.4.1 *Cheese, cheddar*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for flavour following 24 months at 30 °C (Figure K3(e) of Appendix K), and while not significantly different from the compliance criteria, was significantly different from the initial product quality for appearance (p<0.02) and flavour (p<0.002). QDA identified significant decline in colour (p<0.001) and freshness (p<0.003) following storage for 24 months at 30 °C. A discernible decline in buttery aroma and cheddar flavour were also observed.

No discernible changes in net weight, pH or water activity were observed. Significant changes in instrumental texture (stiffness) measurements following 18 months at 30 °C (p<0.001) and 3 months at 40 °C (p<0.001) supported the decline observed in overall (sensory) texture and likely influenced the reduced product freshness.

This product is borderline compliant with warranty requirements—largely due to poor ratings for flavour (60% of batch was likely to fail (at the 95% CI)).

3.3.4.2 *Sweetened condensed milk*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for appearance, texture and flavour following 18 months at 30 °C (Figure K.3(d) of Appendix K), with the texture rating being significantly different from the warranty criteria and the initial product rating. While not significantly different from the compliance criteria, appearance and flavour were significantly different from the initial product quality (p<0.001). QDA identified decline in colour (browning) and the development of an unpleasant aftertaste.

A significant decline in pH (p<0.001) was observed after 18 months at 30 °C, 3 months at 40 °C and 4 weeks at 50 °C, values dropping from 6.3 to 5.8 under warranty conditions.

Significant changes in instrumental colour measurements (L*, a*, b* and Y brightness scales) following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C supported the sensory perception of colour change, becoming significant after 12 months at 30 °C (p<0.02). The onset of NEB, as evident by colour change, is likely to have influenced the sensory ratings.

The water activity, °Brix and net weight were unchanged throughout the storage trial.

This product failed to meet warranty requirements.

3.3.4.3 Milk, dried, skim

Sensory evaluations of milk, dried, skim were conducted on both dry and wet samples. Milk, dried, skim was compliant with sensory quality requirements for warranty (Figure K3 (e) of Appendix K) and did not significantly change in any sensory measure when stored at 1, 20, 30 or 40 °C.

Exposure to temperature (50 °C) extremes (for even the briefest of periods) was found to discernibly change the sweetness, freshness, creaminess, grittiness and colour and instigate the forming of clumps.²⁶ While this is likely seen as a positive for product quality it clearly identified the need to ensure that the product is not stored at extreme temperatures for even a brief period as product failure will result.

The net weight, headspace O_2/CO_2 , solubility and water activity remained constant at or below 40 °C. The pH fluctuated between 6.5 and 6.7 and poses no concern to product SL. No rancidity was observed.

This product met the warranty requirement.

3.3.5 Puddings

All pudding products were compliant with warranty requirement.

3.3.5.1 *Fruit pudding*

Fruit pudding was compliant with sensory quality requirements for warranty (Figure K4 (e) of Appendix K) and did not significantly change in any sensory measure during SL studies.

While discernible changes in colour (instrumental and sensory measurements) and pH were observed, they were somewhat confined to storage at elevated temperatures (\geq 40 °C). No discernible changes in net weight, water activity, (instrumental) texture measures, gauge pressure or headspace were observed.

3.3.5.2 *Chocolate pudding*

Chocolate pudding was compliant with sensory quality requirements for warranty (Figure K4 (e) of Appendix K) and did not significantly change in any sensory measure during SL studies.

A significant decline in pH of both the cake and the sauce (p<0.001) was observed after 18 months at 30 °C, 6 months at 40 °C and 4 weeks at 50 °C, values dropping to 4.8 (from greater than 6) under warranty conditions. The effect of this on the product quality has

 $^{^{26}}$ All of which were found stable attributes when stored at 40 °C and below.

not been realised in any sensory attribute evaluated. The observed decreases in pH may be a result of changes in the sugar chemistry in the sauce. Research suggests decreases in pH during storage of sugar syrups and associated product, has been connected to temperature and the rate of hydrolysis of sugar [19].

No discernible changes in net weight, water activity, colour (instrumental), gauge pressure or headspace were observed. The cohesiveness (instrumental texture measure) did appear to decline on storage however, not significantly, and did not influence overall texture ratings.

3.3.5.3 Golden pudding

Golden pudding was compliant with sensory quality requirements for warranty (Figure K4 (e) of Appendix K) and did not significantly change in any sensory measure during SL studies at 30 °C. Appearance and texture ratings after 9 months at 40 °C were however found significantly different from initial product (p<0.001). QDA identified a discernible decline in colour (browning) and loss of moistness.

QDA analysis of colour change aligns with the discernible changes instrumental colour measurements for both the cake and the sauce. The onset of NEB, as evident by colour change, is likely to have influenced the reduced appearance rating.

A discernible decline in pH of both the cake and the sauce were observed during SL studies, values dropping from 6.3 to 5.5. This decline was also evident in the Chocolate Pudding and warrants further investigation.

No discernible changes in net weight, water activity, texture (instrumental), gauge pressure or headspace were observed.

This product met the warranty requirement.

3.3.6 Fruit grains

The onset of NEB, evident by colour change, was the primary mode of deterioration. Significant change in visual and instrumental measures of colour was observed well short of warranty requirements. The prevalence of colour change was less discernible in the darker coloured fruit grain products.

Preventing the onset and rate of NEB is crucial to maintaining product stability during storage. Fruit grains illustrated varying degrees of NEB during storage and this was the primary deteriorative factor. Novel and innovative processes and/or optimised formulations should be investigated as means to prevent, if not minimise, the effects of NEB. CASG should consult with the manufacturer/supplier to gain further insight into means of achieving product stability and to identify options for improving product quality.

3.3.6.1 *Apricot*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma and appearance following 24 months at 30 °C (Figure K5 of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma, appearance and flavour (p<0.001). QDA identified significant changes in colour (browning), (loss of) apricot flavour and (loss of) white dusting (coating), following storage for 24 months at 30 °C (p<0.001, p<0.001 and p<0.005 respectively).

Significant changes (p<0.001) in instrumental colour measurements (L*, a*, b* and Y brightness scales) following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C supported the sensory perception of colour change. The onset of NEB, as evident by colour change, is likely to have influenced the reduced aroma, appearance and flavour rating.

Stable water activity and net weight results following storage for 24 months at 30 °C indicate that packaging integrity and barrier properties are sufficient to support longevity. What is unclear is the effect of O_2 uptake by the product on it quality during storage. A significant reduction in O_2 content of headspace was evident following 12 months at 30 °C, 3 months at 40 °C and 4 weeks at 50 °C (p<0.001). Levels dropped to below 15% O_2 during storage trials.

No notable textural issues or rancidity were observed.

It is questionable whether or not this product is compliant with warranty requirements.

3.3.6.2 *Raspberry*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma, appearance and flavour following 24 months at 30 °C (Figure K5 of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma and flavour (p<0.002). QDA identified substantial decline in colour (browning), (loss of) raspberry aroma, (loss of) white dusting (coating) and (loss of) fruity flavour following storage for 24 months at 30 °C.

Significant changes (p<0.001) in instrumental colour measurements (L*, a*, b* and Y brightness scales) following 18 months at 30 °C, 6 months at 40 °C and 2 week at 50 °C supported the sensory perception of colour change (p<0.001) after the same period. The onset of NEB, as evident by colour change, is likely to have influenced the reduced aroma, appearance and flavour rating.

Significant change in water activity presented following 6 months at 30 °C and 3 months at 40 °C (p<0.001). Water activity reduced by >0.05 units when stored at 30 °C for 24 months. This is a further reduction on a product that already possessed an a_w of 0.1 units below the specification.

A reducing O_2 in headspace content was observed during SL studies, with higher storage temperature exhibiting a more substantial loss. Respiration that occurs during processing would have ceased. Reducing O_2 levels may have arisen from decomposition of CHO's (possibly in the starch coating). As O_2 levels diminished, CO_2 was released into the headspace and visible signs of the starch coating disappeared.

The net weight of the product remained stable. No notable textural issues or rancidity were observed.

It is questionable whether or not this product is compliant with warranty requirements.

3.3.6.3 Mixed berry

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for appearance and flavour following 24 months at 30 °C (Figure K5 of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma, appearance and flavour (p<0.003). QDA identified substantial decline in colour (browning) following storage for 24 months at 30 °C.

Significant changes in instrumental colour measurements (a* and b* scales) following 12 months at 30 °C (p<0.001) and 6 months at 40 °C (p<0.001) supported the sensory perception of colour change. The onset of NEB, as evident by colour change, was likely to have influenced the reduced aroma, appearance and flavour rating.

Significant change in water activity presented following 6 months at 30 °C and 3 months at 40 °C (p<0.001). The water activity reduced by >0.05 units when stored at 30 °C for 24 months; the product was already 0.05 units below the specification.

A significant reduction of O_2 in headspace content was observed following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C (p<0.005) and continued to reduce over the duration of the trial. Diminishing O_2 levels were commensurate with increased CO_2 levels. [Refer 3.3.6.3 for discussion.]

The net weight of the product remained stable. No notable textural issues or rancidity were observed.

It is questionable whether or not this product is compliant with warranty requirements.

3.3.6.4 *Strawberry*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for appearance following 24 months at 30 °C (Figure K5 of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma (p<0.009), appearance (p<0.003), texture (p<0.001) and flavour (p<0.002). QDA identified discernible changes in colour (browning), (loss of) strawberry aroma and (loss of) white dusting (coating), following storage for 24 months at 30 °C.

Significant changes in instrumental colour measurements (L*, a*, b* and Y brightness scales) following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C (p<0.005, p<0.001 and p<0.001 respectively) supported the sensory perception of colour change. The onset of NEB, as evident by colour change, is likely to have influenced the reduced aroma, appearance and flavour rating.

Stable water activity and net weight results following storage for 24 months at 30 °C indicate that packaging integrity and barrier properties are sufficient to support longevity. What is unclear is the effect of O_2 uptake by the product on it quality during storage. A significant reduction in O_2 content of headspace was evident following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C (p0.001). Levels dropped to below 10% O_2 during storage trials. Diminishing O_2 levels were commensurate with increased carbon dioxide levels. [Refer 3.3.6.3 for discussion.]

No notable rancidity issues were observed.

This product was found borderline compliant with warranty requirements.

3.3.6.5 *Tropical*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for appearance following 24 months at 30 °C (Figure K5 of Appendix K), and while not significantly different from the compliance criteria, were significantly different from the initial product quality for aroma (p<0.008), appearance (p<0.002) and flavour (p<0.001). QDA identified significant changes in colour and chewiness (p<0.001) following 12 months at 30 °C.

Significant changes in instrumental colour measurements (L*, a*, b* and Y brightness scales) following 12 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C (p<0.001) supported the sensory perception of colour change. The onset of NEB, as evident by colour change, is likely to have influenced the reduced aroma, appearance and flavour rating.

Stable water activity and net weight results following storage for 24 months at 30 °C indicate that packaging integrity and barrier properties are sufficient to support longevity. What is unclear is the effect of O_2 uptake by the product on it quality during storage. A significant reduction in O_2 content of headspace was evident following 12 months at 30 °C, 3 months at 40 °C and 1 weeks at 50 °C (p<0.001). Levels dropped to below 14% O_2 during storage trials.

No notable rancidity issues were observed.

This product was found to be borderline compliant with warranty requirements.

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3.3.7 Beverages

Sensory evaluations of instant coffee and chocolate drink powder were conducted on the prepared sample only.

3.3.7.1 *Coffee, instant*

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for aroma and flavour following 24 months at 30 °C (Figure K6 of Appendix K). While high variability in panellists' responses resulted in no significant differences between the warranty requirement and product quality, 40% and 60% of panellists failed the product for aroma and flavour respectively. There is doubt over whether this product is compliant with warranty requirements.

Significant changes (p<0.001) in instrumental colour measurements (L*, a*, b* and Y brightness scales) were observed following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C supported the sensory perception of colour change. QDA also identified the development of burnt/bitter notes in both aroma and flavour however did not appear to be detrimental to the coffee flavour.

The water activity of coffee fluctuated between 0.30 and 0.55 during storage. Net weight correlated with this fluctuation indicating that packaging permeability rates may be permissive of moisture migration should climatic conditions facilitate such. Caking was not evident in this product during trials however storage at high humidity would likely result in such. Storage trials under hot/humid conditions are warranted to ensure the safety and palatability would be retained under these conditions. Clumping was observed in product stored at 50 °C where the relative humidity of the storage environment was low.

While significant changes in pH were observed following 6 months at 30 °C, 3 months at 40 °C and 4 weeks at 50 °C (p<0.001), the effect of this change (a drop to 4.7 from an initial response of 5.0) is likely to be minor.

A reduction in O_2 content of headspace was evident following 12 months at 30 °C, 6 months at 40 °C and 2 weeks at 50 °C. Storage at 50 °C produced discernible levels of CO_2 . No notable rancidity was observed.

This product was found to be borderline compliant with warranty requirements.

3.3.7.2 *Chocolate drink*

Chocolate drink was compliant with sensory quality requirements for warranty (Figure K6 of Appendix K). QDA did not identify any notable changes to aroma, appearance, texture or flavour profiles.

While some fluctuation in colour and caking was observed, no change was significant. The net weight, headspace O_2/CO_2 and pH remained constant. The water activity of coffee fluctuated between 0.2 and 0.4 during storage however no trends with significance were identified under any storage temperature. No rancidity or onset of caking was observed.

This product met the warranty requirement.

3.3.8 Condiments

Non-compliances related to seal width and placement of tear notches were expected to be detrimental to the SL of sauces. As discussed further below, moisture migration was evident in sauce sachets. DST Group analytical capability did not facilitate the evaluation of package integrity of sachets containing liquids and as such was not determined. Investigation into the extent to which seal width and package integrity has facilitated moisture migration is warranted. Nutritional results showed a concentration (at end of warranty period) of all nutrients (Appendix L, Tables L3-L5). This finding correlated with the finding of decreased moisture content at completion of 'warranty' storage.

Delamination was also of concern. Noteworthy was the rejection of the first batch of Worcestershire Sauce delivered to DST Group. The entire batch failed due to visible evidence of delamination.

3.3.8.1 BBQ sauce

BBQ Sauce was compliant with sensory quality requirements for warranty (Figure K7 of Appendix K). While QDA did not identify any significant changes during storage, a colour change from dark brown to black was evident in samples stored at 30 °C. Changes in colour became apparent in instrumental colour measurements (L*, a* and b* with significant change in a* colour following 6 months at 30 °C and 3 months at 40 °C (p<0.001). Moisture migration (egress at elevated temperatures/low humidity) was evident by changes in net weight of sachets and water activity. Significant weight loss occurred in sachets stored for 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C (p<0.002, p<0.001 and p<0.001 respectively). Significant change in water activity presented following 12 months at 30 °C, 3 months at 40 °C and 8 weeks at 50 °C (p<0.001). This correlated with significant increases in °Brix (p<0.001) when stored at the same conditions.

There was no evidence of sachet delamination.

While these quality indicators have not influenced product acceptability, they have highlighted the inferior barrier properties of the packaging to contain its content. Storage of this product for long periods at elevated temperatures and low humidity may reduce the product acceptability.

This product met the warranty requirement.

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3.3.8.2 Sweet chilli sauce

The product mean fell below the cut-off value of 5 on the 9-pt Hedonic scale for appearance following 24 months at 30 °C (Figure K7 of Appendix K). However it was not significantly different from the compliance criteria. Sweet chilli sauce was compliant with other sensory quality requirements for warranty. QDA did identify significant changes in colour and phase separation following storage for 9 months at 40 °C (p<0.001).

Significant changes in instrumental colour measurements (L*, a*, b* and Y brightness scales) following 6 months at 30 °C, 3 months at 40 °C and 2 weeks at 50 °C. Subsequent to the same storage conditions, pH was also significantly different (p<0.001). Moisture migration (egress at elevated temperatures/low humidity) was evident by changes in net weight of sachets. Significant weight loss occurred in sachets stored for 18 months at 30 °C, 6 months at 40 °C and 12 weeks at 50 °C (p<0.002, p<0.001 and p<0.001 respectively). This correlated with significant increases in °Brix and decreased in water activity when product was stored for 6 months at 30 °C, 3 months at 40 °C and 8 weeks at 50 °C (p<0.001). Significant increases in phase separation were evident following storage for 24 months at 30 °C, 6 months at 40 °C and 6 weeks at 50 °C (p<0.001).

Sweet chilli sauce failed the initial requirement for pH. This was exacerbated during storage at elevated temperatures (40 and 50 °C) as the pH declined further with time. This increased acidity did not present itself however in QDA assessment of acidic aroma or flavour. A decline in water activity was also evident during storage, irrespective of the conditions and there was no evidence of sachet delamination.

While these quality indicators have not influenced product acceptability, they have highlighted the inferior barrier properties of the packaging to contain its content. Storage of this product for long periods at elevated temperatures and low humidity may reduce the product acceptability.

This product met the warranty requirement. It was however, borderline. DST Group recommend that there are several quality parameters (including pH, °Brix and water activity) and/or improvements to packaging that can be improved and remove doubt of compliance to warranty requirements.

3.3.8.3 Tomato ketchup

Tomato ketchup was compliant with sensory quality requirements for warranty (Figure K7 of Appendix K). QDA identified a colour change from red to black during storage at 30 °C, and was significant in samples stored at 40 °C for 9 months (p<0.001). Changes in instrumental colour (L*, a*, b* and Y brightness scales) measurements became significant following 18 months at 30 °C, 6 months at 40 °C and 8 weeks at 50 °C (p<0.001). Subsequent to the same storage conditions, pH was also significantly different (p<0.001). Moisture migration (egress at elevated temperatures/low humidity) was evident by changes in net weight of sachets. Significant weight loss occurred in sachets stored for 6 months at 30 °C, 3 months at 40 °C and 6 weeks at 50 °C (p<0.002, p<0.05 and p<0.001).

respectively). This correlated with significant increases in °Brix (p<0.001) when product was stored for 24 months at 30 °C, 6 months at 40 °C and 12 weeks at 50 °C. Somewhat unexpectedly, was the decline in phase separation with time when product was stored at 1, 20 and 30 °C. Potentially, weight loss during storage is obscuring the more likely outcome of increasing phase separation during storage.

There was no evidence of sachet delamination.

While these quality indicators have not influenced product acceptability, they have highlighted the inferior barrier properties of the packaging to contain its content. Storage of this product for long periods at elevated temperatures and low humidity may reduce the product acceptability.

This product met the warranty requirement.

3.3.8.4 *Worcestershire sauce*

Worcestershire sauce was compliant with sensory quality requirements for warranty (Figure K7 of Appendix K). QDA did not identify any significant changes during storage. Moisture migration (egress at elevated temperatures/low humidity) was evident in net weight of sachets. Significant weight loss occurred in sachets stored for 1 year at 30 °C (p<0.001) with a 20% weight loss evident following 2 years. Significant loss was evident following for 3 months at 40 °C (p<0.001) with 40% weight loss after 12 months. This correlated with significant increases in °Brix following 1 year at 30 °C and 6 months at 40 °C (p<0.001). A decline in water activity at elevated temperatures was also evident.

There was no evidence of sachet delamination.

While these quality indicators have not influenced product acceptability, they have highlighted the inferior barrier properties of the packaging to contain its content. Storage of this product for long periods at elevated temperatures and low humidity may reduce the product acceptability.

This product met the warranty requirement.

3.3.8.5 *Fruit spread, raspberry*

Raspberry fruit spread was compliant with sensory quality requirements for warranty (Figure K8 of Appendix K). While the result means did not fall below warranty criteria, 20%, 60% and 60% of panellists failed the product for aroma, appearance and flavour respectively. High variability in panellists' responses resulted in no significant differences being observed between initial product quality and stored product. There is doubt over whether this product is compliant with warranty requirements.

QDA identified a colour change from light red/brown to dark/red/brown storage at 30 °C, becoming significant after 12 months (p<0.001). Changes in instrumental colour were also evident on the a* scale.

Initial water activity (0.82) equilibrated to below 0.8 when stored at 20, 30, 40 and 50 °C, all the while retain levels of > 0.82 when stored at 1 °C. This change was significant (p<0.001) first measurement of samples at each storage temperature.

The level of syneresis, °Brix, pH and net weight were consistent throughout storage.

This product was found borderline compliant with warranty requirements.

3.3.8.6 *Vegetable extract*

Vegetable extract was compliant with sensory quality requirements for warranty (Figure K8 of Appendix K). QDA did not identify any significant changes during storage. Water activity, Colour, pH and net weight were stable throughout storage trials. Serum separation was observed in samples stored at 30, 40 and 50 °C during storage trials however did not present as significant. Serum separation of 2-5% is likely to develop while product is stored.

This product met the warranty requirement.

3.3.8.7 *Pepper, black*

Pepper, black was compliant with sensory quality requirements for warranty (Figure K8 of Appendix K). QDA did not identify any significant changes during storage. Moisture migration (ingress at lower temperatures/high humidity and egress at elevated temperatures/low humidity) was evident in water activity results. While this has not influenced product acceptability it has the potential to affect the microbial stability if the product is stored at high humidity for long periods. Barrier properties of packaging may not be sufficient to preserve the product under all likely conditions of storage, especially in the tropics.

This product met the warranty requirement.

3.4 Summary of product failures

Sections 3.1 to 3.3 above detail the results of verification testing, mainly against the requirements of the ADFFS. Table 8 summarises failures against relevant ADFFS and FSANZ requirements and will assist the reader in identifying the requirements that were most frequently breached.

The reasons why components did not meet one or more ADFFS requirements should be investigated. Aside from simple failure to comply, the reasons may relate to inappropriate requirements such as technical or industry practice difficulties in meeting the requirements or outdated specifications.

Table 9 provides a listing of products that were considered to be of concern. These products were assessed and found to fail either microbiological criteria established by the

IFST [14] or criteria that DST Group recommend be considered for inclusion in future versions of Food Specifications and Standards.

3.5 Summary of specification deficiencies

Sections 3.1 to 3.3 above discuss a number of issues relating to relevance, accuracy and/or omission of performance and functional based specifications for the products evaluated in this QA program. Table 10 summarises the findings and suggests improvements that could be made to the food specifications.

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Problem	Product/s
Not fortified as per ADFFS	Vegetable extract
Thiamine (vitamin B1)	Biscuits (all variants); muesli bar (all variants); muesli mix (all variants);
Low net weight	Muesli mix, fruitful; sauce, BBQ; sauce Worcestershire
High moisture content	Milk, dried, skim; coffee, instant
Low soluble solids (°Bx)	Fruit spread, raspberry; fruit grains, apricot; sauce, BBQ; tomato ketchup
Low total solids	Vegetable extract
High water insoluble residue	Coffee, instant
Inconclusive soluble solids (°Bx)	Fruit grains (raspberry, strawberry and mixed berry variants)
Incorrect product dimensions	Fruit grains (apricot, strawberry, tropical and mixed berry variants)
Low total milk solids	Sweetened condensed milk
Low water activity	Fruit grains (all flavour variants)
Low titratable acidity	Tomato ketchup
Low total acidity	Sauce, BBQ
High pH	Tomato ketchup
Low pH	Sauce, sweet chilli
High particulate residue	Worcestershire sauce
Low ether soluble extract	Pepper, black
Inconclusive yeast count	Sauce, BBQ; tomato ketchup
Inconclusive mould count	Sauce, BBQ; sauce, tomato ketchup; sauce, sweet chilli
High standard plate count	Sauce, sweet chilli
Incorrect package dimensions	Fruit grains (all variants); sauce, sweet chilli; tomato ketchup; pepper, black
Low seal width	Biscuits, cream cracker; biscuits, plain, sweet; biscuits, butter; muesli mix (all variants); chocolate drink powder; coffee, instant; sauce, BBQ; sauce, sweet chilli; tomato ketchup
Absence of tear notch	Biscuits (all variants); muesli bar (all variants); muesli mix, natural; beverage, chocolate drink
Incorrect placement of tear notch (lessening seal width)	Milk, dried, skim; coffee, instant; sauces (all variants)
Incorrect tube thread	Milk, condensed sweetened
Package defect (holes)	Muesli bars (all variants)
Package defect (no vacuum)	Cheese. cheddar
Package defect (dents)	Pudding (all variants); milk, sweetened, condensed; vegetable extract
Package defect (seal integrity)	Muesli bars (all variants)
Package defect (exterior filth)	Milk, condensed sweetened; pudding, chocolate; pudding, golden; fruit spread, raspberry
Package integrity (delamination)	Worcestershire sauce
Incomplete manufacturer details	Beverage, chocolate drink powder
Failure to "declare certain substances in food"	Muesli mix, natural; pudding, fruit; pudding, chocolate; pudding, golden
Incorrect use of 'E' numbers	Fruit grains, raspberry; fruit grains, mixed berry; tomato ketchup
Incomplete nutrition information panel	Milk, dried, skim; milk, condensed sweetened; beverage, chocolate drink powder; Fruits grains (Strawberry, raspberry, mixed berry and tropical variants); Fruit spread; raspberry; vegetable extract; sauces (all variants)
Failure to meet warranty	Biscuits (all variants); muesli bar, apricot & coconut; muesli bar, forest fruits
Inconclusive warranty compliance	Cheese, cheddar; milk, condensed sweetened; fruits grains (apricot, raspberry and mixed berry variants)

 Table 8
 Products that did not meet one or more ADFFS and FSANZ requirements

Problem	Product/s	Requirement of
High standard plate count	Biscuits, crispbread; muesli mix, natural	IFST [14]
High mould count	Muesli mix, fruitful	IFST [14]
High headspace	Puddings (all variants)	DST Group
No preparation instructions	Milk, dried, skim	DST Group
Packaging integrity (microleaks)	Biscuits (all variants); muesli bars (all variants); beverage, chocolate drink powder; fruit grains (all variants)	DST Group

 Table 9
 Products that did not meet IFST and/or DST Group recommended criteria

Table 10Proposed improvements to the food specifications

Improvement	Product
Review and make relevant milk solids content requirement	Milk, condensed sweetened
Review and make consistent requirements for moisture, water activity, pH, titratable acidity and total soluble solids	Sauces, fruit spread, fruit grains (as relevant)
Review need for fortification	All relevant products
Review relevance of dimethylpolysiloxane content	Coffee, instant
Review relevance of ether extract requirement	Pepper, black
Make consistent the performance criteria for SPC, yeasts and moulds	Sauces
In the absence of other high level requirements ²⁷ , implement performance criteria for micro-organisms based on GMP guidance [14]	All products, specifying 'm' and/or 'M' levels#, as required
Review nett weight requirements in line with AQS	All products
Review requirement for product dimensions	Fruit grains
Review requirement for particulate residue	Sauce, Worcestershire
Implement formal requirements for those identified in Table 9	All relevant products
Implement formal requirement for package integrity assessment	All products
Implement formal requirement for labelling to include preparation instructions	Milk, dried, skim
Consider implementing requirement for lactose crystals	Milk, sweetened condensed
Consider implementing formal requirement for sensory quality	All products
Consider implementing requirement for package dimensions	All products
Consider implementing requirement for modified atmosphere packaging	Biscuits, muesli bars, muesli mix, beverages, fruit grains, pepper
Provide methodology for viscosity (by Bostwick method)	Sauces

m- the acceptable microbiological level in a sample unit

M- the level which, when exceeded in one or more samples, shall cause the lot to be rejected

²⁷ Such as FSANZ and industry specific standards

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3.6 Nutritional quality and stability

3.6.1 Manufacturer nutrient claims versus analytical results

A full comparison of manufacturer nutrient claims and the results of chemical analyses is at Tables L1–2 of Appendix L. ADFFS require NIP to be IAW FSANZ, detailing protein, fat- total, fat-saturated, CHO, sugar-total, energy and sodium. In the majority, manufacturers reported accurate results for protein, CHO, sugar and energy. A number of inaccuracies were identified when reporting fat and sodium levels (refer Table L1-2 at Appendix L). In addition to the proximate claims, manufacturers are required to substantiate any claims of fortification and/or nutrient benefit though detailing in the NIP. Table L2 of Appendix L illustrates manufacturers' accuracy in reporting fortificant levels.

FSANZ permits the use of the nutrition panel calculator and/or food composition tables and databases to create NIP²⁸, but note that there are limitations in preparing NIP from such sources. Consequently, it is expected that there will be differences between NIP information and the results of chemical analyses. The US Army Institute of Environmental Medicine has suggested that a variability of 10–20% is acceptable when comparing laboratory results with NIP claims [20].

DST Group has applied a pass/fail criterion (based on +/- 20% disparity) to assess manufacturer compliance. Table 11 details some of the more extreme results identified. In one instance the difference was >1000%. NIP claims for milk, (dried, skim) were found to be approximately 10-fold less than those found analytically. Data reported in the product information form for milk, dried, skim was comparable with analytical results, indicating it is likely that the manufacturer has used incorrect values within the NIP for this product.

In instances where the nutrient concentration was low, the consequence of disparity is likely minor. That said, there is a need to investigated instances where disparity between claimed and analytical results will likely effect CASG's ability to accurately assess the nutrient content of CRP components. DST Group recommend CASG adopt the pass/fail criteria (based on +/-20% disparity) for future assessments of NIP compliance to ensure CASG are positioned to provide accurate guidance on CRP content.

3.6.2 Nutrient levels in initial product

Recommended nutritional criteria (RNC) for general purpose CRP have been developed for the majority of nutrients [21]. Of these the only nutrients with RNC that were not determined in this study were dietary fibre²⁹, vitamin D, pantothenic acid, biotin, choline and molybdenum. Full results of nutrient analysis are available at Appendix L, Table L3-L5.

²⁸ For details refer to the User Guide for Standard 1.2.8 of the Food Standard Code at <u>http://www.foodstandards.gov.au/_srcfiles/revised_NIP_User_guide_july02.pdf</u>

²⁹ Not strictly a 'nutrient', but has nutritional and health effects.

Component	Nutrient	Label claim	Analytical result	% Agreement*
		(/100 g)	(/100 g)	/
Biscuits, crispbread	Sugar	1.8	1.0	180
Muesli bar, apricot & coconut	Sodium	9.4	19.5	48
Muesli bar, forest fruits	Sodium	9.4	20.5	46
Muesli bar, tropical fruit	Sodium	8.4	25.0	38
Muesli mix, fruitful	Sodium	571	74	772
Muesli mix, natural	Sodium	152	41.5	366
Milk, dried, skim	Protein	3.33	28.9	11
	Fat, total	0.0	2.0	NC (< 0.1)
	Fat, saturated	0.0	1.5	NC (< 10)
	CHO, total	3.3	56.2	6
	Sugar	3.3	55.8	6
	Energy	150	1520	10
	Sodium	46.7	245	19
	Calcium	120	845	14
Fruit spread, raspberry	Fat	0.1	0.4	25
	Sodium	2.3	5.3	43
Vegetable extract	Fat, total	<1	1.9	NC (> 50)
	Sugar	< 0.5	2.0	NC (> 400)
Chocolate drink powder	Sodium	20.0	4.5	444
Fruit grains, mixed berry	Fat, total	0.3	0.7	286
Fruit grains, tropical	Fat, total	2	0.4	500
Sauce, BBQ	Sodium	3170	820	387
Tomato ketchup	Fat, total	3.3	0.3	1100

 Table 11
 Poor agreement between manufacturer nutrient claims and analytical results.

*% agreement has been calculated as the proportion of the label claim/analytical result and expressed as a percentage. NC = 'not calculated' due to a missing or non-numerical value for "label claim". Results are reported for disparity of >50%

With the exception of milk, dried, skim (discussed in section 3.6.1), laboratory analysis confirmed all NIP claims for vitamin and mineral fortification (Table L.2 of Appendix L). vegetable extract was found to be fortified with vitamins B_1 , B_2 and B_3 . Vitamin B_1 levels indicated the product was compliant with ADFFS fortificant requirement (15 mg/kg).

Manufacturers were found to claim as little as 50% of the content found analytically. Table L5 of Appendix L illustrates that Vitamin B_2 and B_3 were stable in vegetable extract and as such the manufacturer could be making claims of higher content than currently documented.

Vitamin D has been reported to have greater significance to health than previously believed [22]. Daly et al (2012) concurs stating "Vitamin D deficiency is common in Australia affecting nearly one-third of adults aged \geq 25 years, indicating strategies are needed at the population level to improve vitamin D status of Australians" [23]. There would be benefit in the addition of dietary fibre and vitamin D to the suite of nutrients analysed to assess the nutritional quality of CRP.

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3.6.3 Nutrient stability during storage

Nutrient analysis, as detailed in Section 3.6.1, was repeated on each component following storage for 24 months at 30 °C. Table 12 provides a summary of all those nutrients for which a significant loss during storage was observed and the CRP component was initially a notable contributor of the nutrient. Those instances where the changes were greater than 50% are specifically identified. Whilst singularly these values may not appear noteworthy, combined they have potential to substantially impact on the total nutritional value of CRP menus.

	% Lo	SS
Vitamin	20-50	>50
Vitamin A ²		
Vitamin B ₁	Muesli bar, apricot and coconut; muesli bar, tropical fruits; muesli mix, natural ; pudding, chocolate; cheese, cheddar; vegetable extract ³	Pudding, golden; milk, condensed sweetened
Vitamin B ₂	Biscuits, butter; muesli bar, apricot and coconut; muesli mix, fruitful; milk, condensed sweetened pudding, fruit	
Vitamin B ₆ ²	Biscuits, cream cracker; biscuits, crispbread; milk , dried , skim ; fruits grains (all variants)	Vegetable extract
Vitamin B ₁₂ ²	Pudding, chocolate; pudding, golden	Milk, condensed sweetened
Vitamin C ²	Milk, condensed Sweetened; fruits grains, mixed berry	Muesli mix, fruitful; fruits grains (apricot, tropical, strawberry variants)
Vitamin E ²	Muesli bar (all variants); muesli mix, fruitful; fruit grains, strawberry	Biscuits (all variants); muesli, natural; fruit grains (apricot, raspberry, mixed berry variants)
Vitamin K12	Biscuits, crispbread; muesli bar, apricot and coconut; muesli bar, forest fruits	
Folate	Biscuits, crispbread; muesli mix (all variants)	Biscuits, cream cracker; biscuits, plain, sweet; biscuits, butter; muesli bar (all variants)

Table 12 Changes in nutrient content at the completion of 24 months storage at 30 C^1

1 Products coded green were considered a potential substantial contributor of the referred nutrient in CRP

2 No CR components in the 2009/10 QA program was fortified with this vitamin

3 This product was fortified

DST Group has been tasked to verify the requirement for fortification of CRP components, taking into consideration nutritional requirements, deficiencies in current CRP and the case for and against fortification of CRP, and to identify options for improvements to CRP via fortification [24]. Probert and Bui, 2013 highlighted the need for Defence to rectify inadequate levels of folate, vitamin B₆, vitamin A, vitamin E, vitamin K, iron and calcium [24]. The authors also raised concern over current levels of vitamins B₁, B₁₂ and C with a firm recommendation that Defence investigate options for improving nutrient availability to consumers.

End of warranty results for Vitamin B_1 in Vegetable extract identified significant losses. As such the supplier may be making a false claim in the NIP, given the losses identified during storage (warranty period).

4. Conclusions

4.1 Adherence to specified requirements

Based on the results of chemical, microbiological, physical, visual, sensory and SL testing, all products in the QA testing program for FY 2009/10 failed to meet one or more of the specified requirements (summarised in Table 8).

The requirements that were not met were those of the ADFFS and FSANZ. Additionally, a number of products failed to meet IFST and DST Group recommended requirements (summarised in Table 9).

The chemical requirements were generally met with the exception of those relating to vitamin fortification. Failure to fortify products (with vitamin B_1 as per the ADFFS requirements was the single most common issue. This suggests that the ADFFS requirements have not been enforced with suppliers or that the requirements are either not clear or not practical. It also raises a question as to whether the requirements are well-specified, that is whether the requirements target the best vehicles for fortification, with the most needed fortificants at the right levels of fortification.

Sauce, sweet chilli failed to meet the microbiology requirement for SPC. Physical requirements that were not met relate to net weight, package integrity and form. Labelling problems were frequently encountered with the main issues relating to 'declaration of certain substances' and presence, completeness and accuracy of NIP and manufacturer details.

Biscuits (all variants) and muesli bar (apricot & coconut and forest fruits variants) did not meet warranty requirements. A further 5 products (cheese, cheddar, milk, condensed sweetened and fruits grains (apricot, raspberry and mixed berry variants) returned inconclusive results for warranty compliance.

Many of the components in the 2009/10 QA Program require reformulation, alternative packaging and/or processing conditions to improve initial product quality and facilitate stability during storage. Section 3.3 details proposed actions to improve product quality and stability for biscuits, muesli bars, dairy products and fruit grains. These focus on means to address oxidation, moisture migration, NEB and loss of structural integrity.

4.2 Inadequacies of ADFFS documentation

There is a need to review a number of ADFFS documents (as detailed in Tables 9 and 10) to ensure they are relevant, consistent and complete.³⁰ Subsequently, there is a need to ensure that specifications are implemented as per ADFFS requirements. In some cases, non-conformance to specification was due to outdated or otherwise inappropriate requirements in ADFFS. SL studies identified a number of shortcomings in ADFFS with

³⁰ ADFFS documentation is being progressively reviewed and updated. Future specifications will be published as DEF(AUST) specifications and standards.

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respect to compliance testing of product safety, quality, stability and serviceability at time of consumption.

The ADFFS does not adequately cover the processes that are to be used for the treatment and interpretation of verification test data. Improvements to the standards that support product specifications are required for completeness in documentation and process.

5. Recommendations

The recommendations in this report should be considered in the light of the limitations stated in section 1.2.4. The evaluations reported here were conducted against the specifications in place at the commencement of the study. Since then many of the concerns raised in this report have been rectified. This report should not be considered to be wholly representative of the current state of CRP components, although the types of concerns raised remain relevant and worthy of vigilant monitoring to maintain and improve the quality of CRP components.

5.1 **Recommendation relating to requirements that were not met**

5.1.1 Determine why ADFFS requirements were not met

The reasons why components did not meet one more ADFFS requirements (Tables 8) should be investigated. Three major concerns are:

- Failure to fortify products as per the ADFFS requirements. Problematic components are sauces (BBQ, tomato ketchup, sweet chilli, Worcestershire), vegetable extract, sweetened condensed milk, fruit grains (all variants) and cereal-based products
- Failure to meet warranty requirements. Biscuits and muesli bars were of greatest concern
- Failure to comply with packaging requirements. Major concerns being instances of physical deformity, lack of seal integrity and omission of appropriate tear notches.

5.1.2 Determine why national standards were not met

The following non-compliances with national labelling standards as per the FSC should be investigated.

- Failure to make mandatory declarations of certain substances as per Clause 4 of Standard 1.2.3 for several CRP items
- Incomplete details of 'manufacturer business addresses" for a single CRP item
- Omission of NIP for 100g as per Clause 5 of Standard 1.2.8 on several CRP Items
- Use of additive code numbers that are not IAW Clause 8 of Standard 1.2.4 by using the European approved additive 'E' numbers.

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5.1.3 Other issues for consideration

Whilst there was not a direct breach of ADFFS or national standards, it is recommended that the following issues be investigated:

- Clarity of NIP for foods requiring preparation before consumption. If the NIP relates to the specific stage of product preparation, this should be clearly stated
- Reasons for the large differences between the values in NIP and the analytical results
- Can a level of certainty, or acceptable margin of error, be specified for information contained within NIP?

5.2 **Recommendations relating to deficiencies in the ADFFS**

5.2.1 Ensure ADFFS requirements are appropriately aligned

ADFFS requirements should be aligned with national standards and industry practice except where CRP-specific requirements are necessary. In some cases the failures summarised in Table 8 may be due to deficiencies in the ADFFS requirements. For example:

- The requirement that milk, condensed sweetened contain ≥31% total milk solids is inconsistent with the FSC requirement of ≥28%. There is no CRP-specific requirement for total milk solids content in excess of that required by the FSC
- The SPC requirement for sauce, sweet chilli of 20/g is inconsistent with GMP levels
- The specification for soluble solids content of fruit grains should apply, almost certainly, to the pulp preparation prior to drying, not the finished product.

Table 10 details a number of potential improvements to current food specifications.

5.2.2 Develop functional and performance criteria for food specifications

CRP component specifications should be further developed to set functional and performance criteria for food safety and quality measures. Consideration should be given to specifying basic measures of quality for all CRP components, including:

- Moisture, pH and water activity
- SPC and yeasts and moulds

Consideration should be given to implementing GMP, IFST and DST Group suggested requirements including those detailed in Tables 9 and 10.

5.2.3 Specify new packaging requirements

Specifications should be developed for performance based package integrity test and evaluation of all packages. Table 10 details a number of potential improvements including setting package dimensions (with tolerances) and application of MAP.

5.2.4 Specify verification processes

The processes for determination of pass/fail status of components when conducting verification testing should be developed and stated in ADFFS.

5.2.5 Develop tolerances for acceptance of NIP

An acceptable level of deviation between analytical and NIP values should be defined. There is inherent uncertainty in reported NIP data where calculated from theoretical values, however some observed deviations exceed reasonable tolerances.

5.3 Recommendations relating to initial product quality and enhancing stability

5.3.1 Initial sensory quality

It is recommended that minimum performance criteria for sensory quality of foodstuffs should be developed and documented, preferably in a Defence Standard.

5.3.2 SL extension

To ensure components meet warranty requirements, investigate options to improve the initial sensory quality of CRP foods. This may include consideration of re-formulation, alternative processing techniques and/or packaging.

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7. References

- 1. Department of Defence (2008a) Health Systems Program Office, Combat Rations Fleet, Science and Technology Support Plan 2008/09–2012/13 (5 Years). Department of Defence.
- 2. Department of Defence (2008b) Australian Defence Force Food Specifications (ADFFS), Defence Materiel Organisation, Melbourne, Australia.
- 3. Army Logistics Instruction (ALI), (2009) ALI MM 1-65: Integrated Logistic Support Instruction In-service Management, Health Systems Program Office, Version 3, Land Systems Division, Defence Materiel Organisation, Australia.
- 4. Australian Defence Standard DEF(AUST) 1000C: ADF Packaging, Part 20; Section 2; Chapter 15; Packaging and storage of ration packs in the tropics.
- Horwitz, Dr W. (Ed) (2005) Official Methods of Analysis of AOAC International, 18th Ed., Current through Revision 2, 2007, AOAC International, Gaithersburg, MD, USA.
- 6. Food Standards Australia and New Zealand (FSANZ) (2010) Food Standards Code (FSC) up to and including Amendment 119 as published in Food Standards FSC Gazette. Food Standards Australia New Zealand. ANSTAT, Melbourne, Australia.
- 7. American Society for Testing and Materials (ASTM), (2005) ASTM E2454-05: *Standard guide for sensory evaluation methods to determine the sensory shelf life of consumer products*, American Society for Testing and Materials. West Conshohocken, PA.
- 8. Hootman, R.C., (Ed) (2008) Manual on Descriptive Analysis Testing for Sensory Evaluation, ASTM Manual Series: MNL13, American Society for Testing and Materials West Conshohocken, PA
- 9. Chambers, E. IV and Baker Wolf, M. (Eds) (1996) Sensory Testing Methods: ASTM Manual 26, 2nd Ed., American Society for Testing and Materials, West Conshohocken, PA.
- 10. Standards Australia, 2007 AS 2542.2.3 2007 Sensory analysis Specific methods Guidelines for the use of quantitative response scales (rating), Standards Association of Australia Sydney, Australia.
- 11. Australian Defence Standard DEF(AUST) 10660/Issue 1, Sampling Plans for Conformance Testing of Raw Materials, Packages and Foodstuffs.
- 12. Chung, M., Ruan, R., Chen, P.L., Kim, J., Ahn, T. and Baik, C. (2003) Predicting caking behaviours in powdered foods using a low field nuclear magnetic resonance (NMR) technique. Journal of Food Science and Technology, 36(8):751-761.
- 13. Steele, R., (2004). Understanding and measuring the shelf-life of food, Woodhead Publishing, Cambridge, England.

- 14. Bell, C, Greenwood, M, Hooker, J, Kyriakides, A & Mills, R (1999) Development and Use of Microbiological Criteria for Foods, Institute of Food Science and Technology (IFST), London.
- 15. National Measurement Institute (NMI) (2010). Guide to the Average Quantity System in Australia, Commonwealth of Australia, Canberra ACT, Australia.
- 16. US Food and Drug Authority/Center for Food Safety and Applied Nutrition (USFDA/CFSAN), (2007) Approximate pH of Foods and Food Products, http://www.foodscience.caes.uga.edu/extension/documents/FDAapproximatep Hoffoodslacf-phs.pdf, Last accessed 07/09/2010.
- 17. Australian Dairy Goods Pty Ltd, n.d., Specification for sweetened condensed milk, Accessible at http://www.adgpl.com.au/media/specs/sweetened_cond_can.pdf
- 18. Koros, W.J. (Ed.) (1990) Barrier Polymers and Structures, American Chemical Society Symposium Series # 423.
- 19. Farrokh, F., Mizani, M. and Masoud Honarvar, M., (2012) *Study of Probable Physicochemical Changes During the Storage of Light and Thick Sucrose Syrups*, World Applied Sciences Journal 18 (5): 715-721, International Digital Organization for Scientific Information (IDOSI) Publications, Dubai, UAE.
- 20. McClung, H. (2008) 2008 UPDATE: Ration Nutrient Analysis Program (Presentation), R&DA Improvement Forum, Military Nutrition Division, USARIEM, Massachusetts USA.
- 21. Forbes-Ewan, C. (2009) Australian Defence Force Nutritional Requirements in the 21st Century (Version 1). DSTO-GD-0578, Defence Science and Technology Organisation, Fishermans Bend, Australia.
- 22. Stroud M.L., Stilgoe, S., Stott, V.E., Alhabian, O. and Salman, K. (2000) Vitamin D A Review. Aust. Fam. Physician. 37(12):1002-5.
- 23. Daly, Robin M., Gagnon, Claudia, Lu, Zhong X., Magliano, Dianna J., Dunstan, David W., Sikaris, Ken A., Zimmet, Paul Z., Ebeling, Peter R. and Shaw, Jonathan E. (2012) Prevalence of vitamin D deficiency and its determinants in Australian adults aged 25 years and older : a national, population-based study, Clinical endocrinology, vol. 77, no. 1, pp. 26-35, doi: 10.1111/j.1365-2265.2011.04320.x.
- 24. Probert, B. and Bui, L. (2013) Nutritional Composition of Australian Combat Ration Packs and Options for Improvement, DSTO-TR-2680, Defence Science and Technology Organisation, Fishermans Bend, Australia.

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Appendix A: QA Testing Matrix of 29 Current CRP Components

				Chemical Compliance of Foods					Mic	robio	olog	ical	Com	ıplia	ance	of I	Food	s		Pa	Physica ckages	ıl Co	ompli	ianco	e test	ing Fo	od			Insŗ	ection								
ADFFS	Component number	Sample size (gms)	Moisture Content	Milk Fat Content	Lactose Content	Total Milk Solids	Total Solids Content	Protein Matter (N x 6.25)	Salt Content	Sugar Content	Water Insoluble Residue	Total Soluble Solids	Titratable Acidity	Ether-soluble Extract	Absolute alcohol-soluble	Extract Total Ash	Incubation/sterility	Yeasts & Moulds	Total Plate Count	Filth	B. cereus	Coliforms	Enterobacteriaceace	E coli	Coagulase positive	Salmonella Package dimensions	Leak testing	Gauge pressure	Presence and placement of tear notches	Crimp/Thread width	Heat Seal width	Minimum net mass	Water Activity (aw)	Hq	Particulate matter	Scorched Particles	Grain Size	Branding	Package integrity
1-1-1	Biscuits, cream cracker	35	✓											Т					✓							~	✓		√		✓	\checkmark						\checkmark	✓
1-1-1	Biscuits, plain, sweet	36	✓											Т				1	✓							~	✓		√		✓	✓			\square			\checkmark	✓
1-1-1	Biscuits, butter	35	✓											Т					✓							~	✓		√		✓	~						\checkmark	~
1-1-1	Biscuits, crispbread	40	\checkmark											T					✓							~	✓		√	T	✓	\checkmark						\checkmark	√
1-1-9	Muesli bar, apricot & coconut	32	\checkmark											Т				✓	✓	~						~	✓		√		✓	\checkmark						\checkmark	√
1-1-9	Muesli bar, forest fruits	32	✓											Т				✓	✓	~						~	✓		√		✓	\checkmark						\checkmark	√
1-1-9	Muesli bar, tropical fruit	32	\checkmark															✓	✓	~						~	✓		✓		✓	\checkmark						\checkmark	✓
1-1-10	Muesli mix, fruitful	100	✓															✓	✓	~						~	✓		✓		✓	\checkmark						\checkmark	✓
1-1-10	Muesli mix, natural	100	\checkmark															\checkmark	✓	\checkmark						~	✓		✓		\checkmark	\checkmark						\checkmark	✓
2-2-2	Cheese, cheddar	56	~	~	✓													✓	✓							~						\checkmark						\checkmark	✓
2-5-3	Milk, condensed, sweetened	85		~		\checkmark											✓	✓	✓							~			✓	✓		\checkmark						\checkmark	✓
2-5-4	Milk, dried, skim	3	~	✓									✓						✓			✓			√ .	 	✓		✓		✓	\checkmark				\checkmark		\checkmark	✓
4-7-4	Pudding, fruit	350																✓	✓							~		✓	✓			\checkmark						\checkmark	✓
4-7-4	Pudding, chocolate	300																✓	✓							~		✓	✓			\checkmark						\checkmark	✓
4-7-4	Pudding, golden	300																✓	✓							~		✓	✓			\checkmark						\checkmark	√
4-5-1	Fruit spread, raspberry	50	\checkmark									\checkmark						\checkmark	\checkmark							 			✓	\checkmark		\checkmark						\checkmark	✓
4-5-2	Vegetable extract	15					✓	\checkmark	\checkmark								\checkmark	\checkmark	\checkmark							~			✓	\checkmark		\checkmark						\checkmark	✓
8-1-14	Beverage, chocolate drink powder	40	\checkmark							\checkmark									\checkmark			\checkmark			√ ·	 	\checkmark		✓		\checkmark	\checkmark						\checkmark	\checkmark
8-1-7	Beverage, coffee, instant	3.5	\checkmark								\checkmark								\checkmark							~	\checkmark		✓		\checkmark	\checkmark						\checkmark	✓
8-2-2	Fruit grains, apricot	15										✓							\checkmark							~	\checkmark		✓		\checkmark	\checkmark	\checkmark				\checkmark	\checkmark	✓
8-2-2	Fruit grains, raspberry	15										✓							\checkmark							~	\checkmark		✓		\checkmark	\checkmark	\checkmark				\checkmark	\checkmark	\checkmark
8-2-2	Fruit grains, mixed berry	15										✓							\checkmark							~	✓		✓		\checkmark	\checkmark	\checkmark				\checkmark	\checkmark	✓
8-2-2	Fruit grains, strawberry	15										✓							\checkmark							~	✓		√		\checkmark	\checkmark	\checkmark				\checkmark	\checkmark	✓
8-2-2	Fruit grains, tropical	15										✓							✓							~	✓		√		\checkmark	\checkmark	\checkmark				\checkmark	\checkmark	✓
8-3-31	Sauce, BBQ	10										√	✓				✓	✓	✓		\checkmark		✓	\checkmark		 	✓		√		\checkmark	\checkmark		\checkmark				\checkmark	√
8-3-20	Sauce, sweet chilli	10							✓			✓	✓				✓	✓	\checkmark							~	✓		✓		✓	\checkmark		✓				\checkmark	~
8-3-21	Sauce, tomato ketchup	15										✓	✓				✓	✓	\checkmark							~	✓		✓		✓	\checkmark		✓				\checkmark	~
8-3-23	Sauce, worcestershire	10											✓				✓	✓	✓							~	✓		√	1	 ✓ 	✓		\vdash	\checkmark			\checkmark	\checkmark
8-3-15	Pepper, black	2												~	 ✓ 	√		\checkmark	\checkmark							<</td <td>✓</td> <td></td> <td>✓</td> <td></td> <td>\checkmark</td> <td>\checkmark</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\checkmark</td> <td>√</td>	✓		✓		\checkmark	\checkmark						\checkmark	√

Table A1 Chemical, microbiological, physical and visual compliance requirements (as per ADFFS)

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Table A2 Chemical, microbiological, physical and visual compliance requirements (as per ADFFS)

												Fu	ull Nu	utriti	onal	anal	ysis (at tir	ne z	ero	and	tim	e 24	mo	nth	s)									
ADFFS	Component name	Sample size	Energy	Protein	Fat	Moisture	Ash	Carbohydrate	Sugars	Saturated fat	Polyunsaturated fat	Monounsaturated fat	Trans-unsaturated fat	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin B_6	Vitamin B ₁₂	Vitamin C	Vitamin E	Vitamin K	Folate	Calcium	Phosphorus	Iron	Zinc	Sodium	Potassium	Magnesium	Copper	Manganese	Iodine	Selenium	Chromium
1-1-1	Biscuits, cream cracker	35	\checkmark	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark
1-1-1	Biscuits, plain, sweet	36	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
1-1-1	Biscuits, butter	35	\checkmark	✓	✓	✓	✓	✓	~	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
1-1-1	Biscuits, crispbread	40	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
1-1-9	Muesli bar, apricot & coconut	32	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
1-1-9	Muesli bar, forest fruits	32	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
1-1-9	Muesli bar, tropical fruit	32	\checkmark	✓	✓	\checkmark	✓	✓	\checkmark	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	√	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark
1-1-10	Muesli mix, fruitful	100	\checkmark	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	√	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark
1-1-10	Muesli mix, natural	100	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark
2-2-2	Cheese, cheddar	56	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	١R	√	✓	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark
2-5-3	Milk, condensed, sweetened	85	\checkmark	✓	\checkmark	✓	✓	✓	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	√ I	١R	√	√	✓	\checkmark	✓	✓	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark
2-5-4	Milk, dried, skim	3	\checkmark	✓	\checkmark	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	√	√ I	١R	√	√	✓	\checkmark	✓	✓	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark
4-7-4	Pudding, fruit	350	\checkmark	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	√	١R	√	✓	✓	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
4-7-4	Pudding, chocolate	300	\checkmark	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	√	١R	√	✓	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark
4-7-4	Pudding, golden	300	\checkmark	~	✓	✓	✓	✓	✓	✓	\checkmark	✓	✓	✓	✓	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	√ I	١R	√	✓	✓	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
4-5-1	Fruit spread, raspberry	50	\checkmark	✓	✓	\checkmark	✓	✓	✓		N	IR		✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	√ I	١R	√	√	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark
4-5-2	Vegetable extract	15	\checkmark	✓	✓	✓	✓	✓	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	√	١R	√	✓	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark
8-1-14	Beverage, chocolate drink powder	40	\checkmark	✓	\checkmark	✓	\checkmark	✓	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	√ I	١R	√	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
8-1-7	Beverage, coffee, instant	3.5	\checkmark	✓	✓	\checkmark	✓	✓	✓													NR													
8-2-2	Fruit grains, apricot	15	\checkmark	✓	✓	✓	✓	✓	✓		Ν	IR		✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	✓	✓	✓	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	\checkmark	✓	✓	\checkmark
8-2-2	Fruit grains, raspberry	15	\checkmark	✓	✓	✓	✓	✓	✓		Ν	IR		✓	✓	✓	✓	\checkmark	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark
8-2-2	Fruit grains, mixed berry	15	\checkmark	✓	✓	\checkmark	✓	✓	\checkmark		Ν	IR		✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark						
8-2-2	Fruit grains, strawberry	15	\checkmark	✓	✓	\checkmark	✓	✓	✓		Ν	IR		✓	✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	✓	✓	√	✓	\checkmark	\checkmark	✓	\checkmark	\checkmark	✓	✓	✓	\checkmark	\checkmark
8-2-2	Fruit grains, tropical	15	\checkmark	✓	✓	✓	✓	✓	✓		Ν	IR		✓	\checkmark	✓	✓	\checkmark	\checkmark	\checkmark	\checkmark	✓	✓	√	√	\checkmark	\checkmark	✓	✓	\checkmark	✓	✓	✓	\checkmark	\checkmark
8-3-31	Sauce, BBQ	10	\checkmark	✓	✓	✓	✓	✓	✓							NR								√	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark	✓	✓	\checkmark	\checkmark
8-3-20	Sauce, sweet chilli	10	\checkmark	✓	✓	\checkmark	✓	✓	\checkmark							NR								√	✓	\checkmark	\checkmark	✓	\checkmark						
8-3-21	Sauce, tomato ketchup	15	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	~							NR								\checkmark	\checkmark	\checkmark	\checkmark	✓	\checkmark						
8-3-23	Sauce, worcestershire	10	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark							NR								\checkmark	✓	\checkmark	\checkmark	✓	\checkmark						
8-3-15	Pepper, black	2																NF	२																
NR Ana	llysis not required given negligible co	ntribu	utior	to c	overa	all n	utrit	iona	l coi	ntent																									

Appendix B: CRP Component Receival

Table B1 Requirements and delivery

	Fill	Total No of	Total No			Product
Product Name/Type (Current)	mass	Pkt	of Pkt	Batch code	Date received	supply
	(g)	requested	provided			source
Biscuits, Cream Cracker	35	400	405	090605	05-Jan-10	PrePack
Biscuits, Plain, Sweet	36	450	336	PKD 05/10/2009	05-Jan-10	PrePack
Biscuits, Butter	35	400	443	090901	05-Jan-10	PrePack
Biscuits, Crispbread	40	350	375	PKD 29/09/2009	05-Jan-10	PrePack
Muesli bar, Apricot & Coconut ¹		-	432	274	31-Aug-09	Manufacturer
Muesli bar, Apricot & Coconut	32	450	451	275	10-Dec-09	PrePack
Muesli bar, Forest Fruits ¹		-	413	191	31-Aug-09	Manufacturer
Muesli bar, Forest Fruits	32	450	432	192	10-Dec-09	PrePack
Muesli bar, Tropical Fruit ¹		-	429	240	31-Aug-09	Manufacturer
Muesli bar, Tropical Fruit	32	450	324	240	10-Dec-09	PrePack
Muesli Cereal, Fruitful	100	320	314	090623	10-Dec-09	PrePack
Muesli Cereal, Natural	100	320	314	090217	10-Dec-09	PrePack
Cheese, Cheddar	56	365	333	P 27.08.2009	10-Dec-09	PrePack
Milk, Condensed Sweetened	85	335	297	B240809, B040509, B190809	10-Dec-09	PrePack
Milk, Dried, Skim	3	3000	3000	PKD 02/09/2009	10-Dec-09	PrePack
Potato and Onion Powder ²	50	300	0	-	-	-
Pudding, Fruit ¹		-	300	8169	01-Oct-09	Manufacturer
Pudding, Fruit	350	310	300	8169	10-Dec-09	PrePack
Pudding, Chocolate ¹		-	300	8215	01-Oct-09	Manufacturer
Pudding, Chocolate	300	310	300	8215	10-Dec-09	PrePack
Pudding, Golden ¹		-	300	8216	01-Oct-09	Manufacturer
Pudding, Golden	300	310	300	8216	10-Dec-09	PrePack
Fruit Spread, Raspberry	26	570	575	PKD 23/04/09	05-Jan-10	PrePack
Vegetable Extract	15	640	592	PKD 04/05/09	10-Dec-09	PrePack
Beverage, Chocolate Drink Powder ¹			370	9257 pkd 14/09/09	18-Sep-09	
Beverage, Chocolate Drink Powder	40	365	350	9257	10-Dec-09	PrePack
Beverage, Coffee, Instant	3.5	2700	2684	PKD 10/08/09	10-Dec-09	PrePack
Fruit Grains, Apricot	15	615	611	PKD 08/09/2009	10-Dec-09	PrePack
Fruit Grains, Raspberry	15	615	611	PKD 31/08/2009	10-Dec-09	PrePack
Fruit Grains, Mixed Berry	15	615	611	PKD 12/05/2009	10-Dec-09	PrePack
Fruit Grains, Strawberry	15	615	611	PKD 19/05/2009	10-Dec-09	PrePack
Fruit Grains, Tropical	15	615	611	PKD 21/05/2009	10-Dec-09	PrePack
Sauce, BBQ	10	600	602	25/05/2009	10-Dec-09	PrePack
Sauce, Sweet Chilli	10	600	593	18/05/2009	10-Dec-09	PrePack
Sauce, Tomato Ketchup	15	600	596	23/04/2009	10-Dec-09	PrePack
Sauce, Worcestershire	10	600	596	PKD 03/02/2010	10-Dec-09	PrePack
Sauce, Worcestershire	10	600	643	PKD 17/11/2009	07-Apr-10	PrePack
Pepper, black	2	3650	3584	PKD 23/09/2009, PKD 14/09/2009	10-Dec-09	PrePack

¹ Products were not used in the 09/10 QA program. All items were quarantined and disposed of. ² Not procured for 09/10 build. Product was replaced by Fruit Spread, Raspberry in the 09/10 QA Program.

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Tab	le	B2	Visual	insp	pection	of pi	ackagi	ing d	lefe	ects
						, ,				

	Total No of	Product			
Product Name/Type (Current)	Pkt	Supply	Critical defects	Major defects	Minor Defects
	Inspected	Source			
Biscuits, Cream Cracker	405	PrePack	-	-	V
Biscuits, Plain, Sweet	336	PrePack	-	-	
Biscuits, Butter	443	PrePack	-	-	
Biscuits, Crispbread	375	PrePack	-	-	
Muesli bar, Apricot & Coconut ¹	432	Manufacturer	33 [holes (11), compressed seal (5), wrinkles (17)[286 [compressed seal (268), wrinkles (18)]	33 [seal wrinkles]
Muesli bar, Apricot & Coconut	451	PrePack	-	-	-
Muesli bar, Forest Fruits¹	413	Manufacturer	48 [holes (23), wrinkles (25)]	338 [compressed seal (274), wrinkles (64)]	37 [seal wrinkles]
Muesli bar, Forest Fruits	432	PrePack	-	-	-
Muesli bar, Tropical Fruit ¹	429	Manufacturer	44 [holes (11), wrinkles (33)]	344 [compressed seal (313), wrinkles (31)]	41 [seal wrinkles]
Muesli bar, Tropical Fruit	324	PrePack	-	-	-
Muesli Cereal, Fruitful	314	PrePack	-	-	-
Muesli Cereal, Natural	314	PrePack	-	-	-
Cheese, Cheddar	333	PrePack	-	1 [double seam dent]	21 [loss of vacuum]
Milk, Condensed Sweetened	297	PrePack	10 [1 puncture, 9 exterior cleanliness]	-	288 [body dents]
Milk, Dried, Skim	3000	PrePack	-	-	-
Pudding, Fruit ¹	300	Manufacturer	5 [exterior filth on cans]	-	-
Pudding, Fruit	300	PrePack	1 [exterior filth on cans]	-	1 [body dent]
Pudding, Chocolate ¹	300	Manufacturer	300 [exterior filth on cans, loss of hermetic seal (2)]	2 [spur.]	23 [5 minor droop, 2 double seam dent, 16 body dents]
Pudding, Chocolate	300	PrePack	8 [exterior filth on cans]	-	2 [body dent]
Pudding, Golden ¹	300	Manufacturer	300 [exterior filth on cans]	-	12 [body dent]
Pudding, Golden	300	PrePack	97 [exterior filth on cans]	-	6 [1 double seam dent, 5 body dents]
Fruit Spread, Raspberry	575	PrePack	-	-	575 [body dents]
Vegetable Extract	592	PrePack	7 [exterior cleanliness]	-	-
Beverage, Chocolate Drink Powder ¹	370	Manufacturer	1 [hole]	-	4 [seal wrinkles]
Beverage, Chocolate Drink Powder	350	PrePack			
Beverage, Coffee, Instant	2684	PrePack	-	-	-
Fruit Grains, Apricot	611	PrePack	-	-	-
Fruit Grains, Raspberry	611	PrePack	-	-	-
Fruit Grains, Mixed Berry	611	PrePack	-	-	-
Fruit Grains, Strawberry	611	PrePack	-	-	-
Fruit Grains, Tropical	611	PrePack	-	-	-
Sauce, BBQ	602	PrePack	-	-	-
Sauce, Sweet Chilli	593	PrePack	-	-	-
Sauce, Tomato Ketchup	596	PrePack	-	-	-
Sauce, Worcestershire ¹	596	PrePack	596 [de-lamination of pouches]	-	-
Sauce, Worcestershire	643	PrePack	-	-	-
Pepper, black	3584	PrePack	-	-	-

¹Products were not used in the 09/10 QA program. All items were quarantined and disposed of.

 Table B3
 Leak testing of products (in flexible packaging) using Seal Vac Leak Tester

Product Name	Tested	Leak Test Failed	%Fail
Biscuits, Cream Cracker	402	1	0.3
Biscuits, Plain Sweet	312	13	4.2
Biscuits, Butter	363	5	1.4
Biscuits, Crispbread	329	17	5.2
Muesli Bar, Apricot & coconut	415	29	7.0
Muesli Bar, Forest Fruits	415	70	16.9
Muesli Bar, Tropical fruit	415	131	31.6
Muesli Cereal, Fruitful	313	1	0.3
Muesli Cereal, Natural	302	8	2.7
Milk, dried, skim	2745	77	2.8
Chocolate Drink Powder	387	33	8.5
Fruit Grains, Apricot	611	68	11.1
Fruit Grains, Raspberry	611	289	47.3
Fruit Grains, Mixed Berry	611	1	0.2
Fruit Grains, Strawberry	611	3	0.5
Fruit Grains, Tropical	611	36	5.9
Appendix C: Methods of Analysis

Table C1Methods of analysis for compliance testing

Chemical compliance of food

Analysis	Product matrix	Method type	Reference material: AOAC/AS/Journal/ Method/ADFFS
Moisture	Cereal products, fruit spread, raspberry, chocolate Drink powder, instant coffee	Vacuum oven drying method (60-70 °C), with or without sand (depending on sample)	AOAC 964.22, AOAC 934.06
Fat (milk)	Cheese cheddar, sweetened condensed Milk, dried, skim	Enzymatic digestion method	AOAC 960.39
Lactose content	Cheese, cheddar	Determination of lactose	AOAC 930.32
Total milk solids	Sweetened condensed milk	Calculation using total solids/sucrose content	AS 2300.Part 5.3
Total solids	Vegetable extract	Determination of total solids (moisture)	AOAC 925.45D
Protein	Vegetable extract	Determination of total nitrogen and calculation of protein	AS2300.1.2.1
Salt	Vegetable extract, sweet chilli sauce	Sodium chloride content (Volhard method)	AOAC 971.27
Total sugars	Chocolate drink powder	Sugars by HPLC	AOAC 930.13
Water insoluble residue	Instant coffee	Determination by filtration	in-house laboratory method
Total soluble solids	Fruit grains, fruit spread	Refractometer method	AOAC 932.12
Total soluble solids	Sauces	Refractive Index method	AOAC 970.59
Total ash	Pepper, black	Direct method (furnace)	AOAC 923.03
Alcohol extractable	Pepper, black	Details unknown	AOAC 991.36 (modified)
Ether soluble extract	Pepper, black	Extraction of fat using soxhlet	AOAC 991.36
Total acidity	BBQ sauce	Determination of acidity (titratable) – Indicator method with sodium hydroxide	AOAC 942.15
Final acidity (as acetic)	Sweet chilli sauce, tomato ketchup, Worcestershire sauce	Determination of acidity (titratable) – Indicator method with sodium hydroxide	AOAC 942.15
Titratable acidity (as lactic)	Milk, dried, skim	Determination of acidity (titratable) – Indicator method with sodium hydroxide	AOAC 947.05

Microbiological compliance of food

Examination	Product matrix	Method type	Reference material: AOAC/AS/Journal/ Method/ADFFS
Total viable aerobic count (standard plate count)	All samples	Standard plate count	AS1766.1.4
Commercial sterility	Milk, condensed, sweetened, vegetable extract, sauces	This method sets out the procedure for the microbiological examination of heat- processed foods in hermetically sealed containers for commercial sterility.	 Compendium of Methods for the microbiological examination of foods. Third Edition. Marvin L. Speck, Editor 1992. AS 1766.3.7 – 1986: Heat-processed foods in hermetically sealed containers. 17.6.01 – Microbiological Methods / Sterility (Commercial) of Foods (Canned, Low Acid). AOAC Official Method 972.44.
Filth test	Muesli mix, muesli bars	Stereomicroscopic method	In-house laboratory method
Yeasts & moulds	Muesli mix, muesli bars, puddings, fruit spread, sauces, pepper, black	Colony count of yeasts and moulds	AS 5013.29
Coliforms	Milk, dried, skim, chocolate drink powder	Detection and enumeration by calculation of the most probable number (MPN)	AS1766.2.3
Salmonella	Milk, dried, skim, fruit spread, chocolate drink powder, BBQ sauce, pepper, black	Qualitative detection of salmonella (cultural method)	AS5013.10
E.coli	BBQ sauce	Detection and enumeration by calculation of the MPN	AS5013.15
Bacillus cereus	BBQ sauce	Colony-count technique at 30°C	AS 5013.2
Enterobacteriaceae	BBQ sauce	Detection and enumeration by counting colonies in a solid medium after incubation at 35 °C or 37 °C.	AS 5013.8
Coagulase positive staphylococci	Milk, dried, skim, chocolate drink powder	Surface spread.	AS 5013.12.1/5013.12.3

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Physical compliance of food

Analysis	Product matrix	Method type	Reference Material: AOAC/AS/Journal Method/ADFFS
Net weight	All products	Manual weighing using an electronic balance	ADFFS Part D
рН	Sauces	Determination of pH	AOAC (2007) 981.12
Water activity (aW)	Fruit grains	Dew point Instrument	AOAC (2007) 978.18
Grain size	Fruit grains	Vernier calliper measurement of dimensions	DST Group In-house method
Scorched particles	Milk, dried skim	Filtration and drying with disc classification	AS 2300.4.5
Particulate matter	Worcestershire sauce	Sieve 300µm	DST Group In-house method

Physical compliance of packaging

Analysis	Product matrix	Method type	Reference material: AOAC/AS/Journal Method/ADFFS
Package dimensions	All products	Vemier calliper measurement of external dimensions	DST Group In-house method
Leak testing	Biscuits, cereal products, milk, dried skim, chocolate drink powder, instant coffee, fruit grains, sauces, pepper, black	Vacuum decay method	DST Group In-house method
Gauge pressure	Puddings	Measurement using Budenberg F.I.R.A vacuum gauge	ADFFS Part D
Seal width	Biscuits, cereal products, milk, dried skim, chocolate drink powder, instant coffee, fruit grains, sauces, pepper, black	Vernier calliper measurement of thread diameter and crimp width	DST Group In-house method
Crimp and thread width	Milk, condensed sweetened, vegetable extract, fruit spread	Vernier calliper measurement of minimum depth	DST Group In-house method
Presence/ placement of notches	Cereal products, milk, dried skim, chocolate drink powder, instant coffee, sauces, pepper, black	Visual observation and vernier calliper measurement	DST Group In-house method

Visual inspections for compliance

Inspection	Product matrix	Method type	Reference material: AOAC/AS/Journal Method/ADFFS
Branding and labelling	All products	Visual observation IAW FSC and ADFFS requirements	DST Group In-house method
Packaging integrity; Defect inspection	All products	Visual observation IAW ADFFS requirements, including lacquer stripping, package swells, delamination	DST Group In-house method with guidance from DEF(AUST) 10658, Appendix G

Table C2Methods of analysis for nutrient composition

Nutrient	Reference material: AOAC/AS/Journal publication
Protein	AS2300.1.2.1
Moisture	AOAC 934.01
Ash	AOAC 923.03
Fat, total	AS2300.1.3 (Dairy Products), relevant AOAC monographs for other matrices
Fat, (sat., trans-, mono-unsat., poly unsat.)	AOAC963.22
CHO (Total), energy (by calculation)	Food Standards Code – FSANZ
Total sugars	AOAC 930.13
Vitamin A	Methods for Determination of Vitamins in Foods Recommended by COST 91 ed. by Brubacher, Muller-Mulot & Southgate.
Vitamin B $_1$ (Thiamine) and Vitamin B $_2$ (Riboflavin)	 AOAC 942.23 describes the digestion procedure to release vitamin Simultaneous Determination of Thiamin and Riboflavin in Selected Foods by High-Performance Liquid Chromatography Fellman et al. J of Food Science vol 47 1982 p 2048
Vitamin B₃ (Niacin)	 The determination of niacin in cereals, meat and selected foods by capillary electrophoresis and high performance liquid chromatography,. C.M. Ward and V.C. Trenerry. Food Chemistry, 60 667 (1997). The determination of total niacin in concentrated yeast spreads by capillary electrophoresis C.M. Ward, V.C. Trenerry and I. Pant, Food Chemistry, 58 185 (1997).
Vitamin B ₆	Determination of Vitamin B6 in Food by HPLC, M. Bergaentzle, F. Arella, J.B. Bourgnon & C. Hasslemann Food Chemistry, 52 81-86 (1995).
Vitamin B ₁₂ , Folate	 Methods for the Microbiological Analysis of Selected Nutrients AOAC 1996 4th EU Mat Interlaboratory Study, 1995. Alba, D., AGAL, PIP Report on Method Development for the Microbiological Assay of Folates, February 1997
Vitamin C	 Brubacher, G., Muller-Mulot, W. and Southgate, D.A.T. (eds), 'Methods for the Determination of Vitamins in Food', (1985) Elsevier Applied Science Publishers Ltd Ch 5 Tran, S., Wyatt, J. and Anglemier,, A.F. J. Micronutrient Analysis 3 211-228 (1987). Albrecht, J. and Schafer, N.W. J. Liquid Chromatography, 13 (13), 2633-2641(1990). Marshall, P.A., Trenerry, V.C. and Thompson, C.O The Determination of Total Ascorbic Acid in Beers, Wines and Fruit Drinks by Micellar Electrokinetic Capillary Chromatography. J. Chrom. Sci., 33, 426-432 (1995) Thompson, C.O. and Trenerry, V.C. A rapid method for the determination of total L-ascorbic acid in fruits and vegetables by micellar electrokinetic capillary chromatography. Food Chem., 53, 43-50 (1995)
Vitamin E	Methods for Determination of Vitamins in Foods Recommended by COST 91 ed. by Brubacher, Muller-Mulot & Southgate.
Vitamin K ₁	AOAC 999.15
lodine	Determination of iodine in food samples by inductively coupled plasma mass spectrometry after alkaline extraction, Journal of Analytical Atomic Spectrometry, September, 13 977-982 (1998)
Manganese, phosphorus, sodium, potassium, copper, magnesium, zinc, calcium, iron, selenium, chromium	US-EPA Method 6020 Inductively Coupled Plasma - Mass Spectrometry. US-EPA Method 6010B Inductively Coupled Plasma - Atomic Emission Spectrometry.

Analysis	Method type	Reference material: AOAC/AS/Journal Method/ADFFS/ASTM
Sensory acceptability	Consumer acceptability using a 9-point Hedonic Rating Scale for aroma, appearance, texture and flavour attributes	DST Group In-house method based on ASTM Manual 26 (1996) 2nd Ed. and AS 2542.2.3
Quantitative descriptive analysis	Individual assessment of characterising and changing elements of aroma, appearance, texture and flavour attributes through responses on an anchored continuous line scale	DST Group In-house method based on AS 2542.2.3 and ASTM Manual 13.(2008)
Net weight	Manual weighing using an electronic balance	ADFFS Part D
Water activity	Dew point instrument	DST Group In-house method based on AOAC 978.18C
рН	pH meter	DST Group In-house method based on AOAC 981.12
Colour change	Light reflectance measurement using a colour meter	DEF(AUST) 10658 Appendix D, method D.3.
Headspace O2/CO2 content	Measurement of% O2 and carbon dioxide in air sample surrounding product	DEF(AUST) 10658, Appendix G, Method G.47.
Gauge pressure	Measurement using Budenberg F.I.R.A vacuum gauge	DEF(AUST) 10658 Appendix G, method G.15.
Total soluble solids (Brix)	Refractometer method	AOAC (2006) 932.12 or AOAC (2006) 932.14
Particulate residue	Sieve 300µm	DST GroupO In-house method
Phase separation (% serum)	Measurement of serum separated from product after 3 hours	DST Group In-house method
Phase separation	Blotter card (1/2 hour)	DST Group In-house method
Texture analysis	Texture profile analysis, snap test or single hardness using a Lloyd's Texture Analyser	DST Group In-house method
Solubility	Dissolution and filtration	DST Group In-house method
Caking	Sieve 500µm	DST Group In-house method
Nutritional content	Testing as per scope of Table C.2 (above)	Refer Table C.2
Changes in packaging integrity and/or presentation	Visual observation of defects including lacquer stripping, package swells, delamination, unfolding crimp	DST Group In-house method with guidance from DEF(AUST) 10658. Appendix G

Table C3Methods of analysis for shelf life assessment

Appendix D: Sampling and Testing Regime for Storage Trial Samples

 Table D1
 Sampling plan and scope of inspection and testing for shelf life assessment¹

	Sens	sory ²							Phy	sico-che	emical						Visi	Jal
	9-pt Hedonic rating	QDA	Net weight	Water activity	Hd	Colour change	Brix	Texture analysis	Particulate residue	Phase separation (% serum separation)	Phase separation (blotter card)	Changes in solubility	Caking	Headspace 02/C02	Gauge pressure	Nutritional content ³	Product integrity	Package integrity
Biscuits, cream cracker	5	5	5-8	3		3		6-12						8		2	8	8
Biscuits, plain, sweet	5	5	5-8	3		3		4-9						5-8		2	8	8
Biscuits, butter	5	5	5-8	3		3		4-6						5-8		2	8	8
Biscuits, crispbread	5	5	5-8	3		3		6-12						8		2	8	8
Muesli bar, apricot & coconut	5	5	6-8	3		3		3						8		2	8	8
Muesli bar, forest fruits	5	5	6-8	3		3		3						8		2	8	8
Muesli bar, tropical fruit	5	5	6-8	3		3		3						8		2	8	8
Muesli mix, fruitful	5	5	5-8	3		3								8		2	8	8
Muesli mix, natural	5	5	5-8	3		3								8		2	8	8
Cheese, cheddar	5	5	3-5	3	3	3		3								2	8	8
Milk, condensed sweetened	5	5	3-5	3	3	3	3									2	8	8
Milk, dried, skim	5	5	8	3	3	3						3	3	8		2	8	8
Pudding, fruit	5	5	5	3	3	3		3							3-4	2	8	8
Pudding, chocolate	5	5	5	3	3	3		3							3-4	2	8	8
Pudding, golden	5	5	5	3	3	3		3							3-4	2	8	8
Fruit spread, raspberry	5	5	5	3	3	3	3			3						2	8	8
Vegetable extract	5	5	5	3	3	3				2-3						2	8	8
Chocolate drink powder	5	5	8	3	3	3						3	3	8		2	8	8
Coffee, instant	5	5	8	3	3	3						3	3	8		2	8	8
Fruit grains, apricot	5	5	8	3		3								8		2	8	8
Fruit grains, raspberry	5	5	8	3		3								8		2	8	8
Fruit grains, mixed berry	5	5	8	3		3								8		2	8	8
Fruit grains, strawberry	5	5	8	3		3								8		2	8	8
Fruit grains, tropical	5	5	8	3		3								8		2	8	8
Sauce, BBQ	5	5	5	3	3	3	3				3					2	8	8
Sauce, sweet chilli	5	5	5	3	3	3	3				3					2	8	8
Tomato ketchup	5	5	5	3	3	3	3				3					2	8	8
Sauce, Worcestershire	5	5	5	3	3	3	3		3							2	8	8
Pepper, black	5	5	5	3		3								5		2	8	8

¹Numbers in the table indicate the number of individual packets tested at each sampling point

² Evaluations conducted with 5 panellists on pooled samples of individual packet numbers as indicated

³Tests conducted on pooled samples (minimum of 10 packets).

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Appendix E: Results of Components Analysed for Chemical Compliance to ADFFS

Component					Мс	oisture (%	% w/w)				Fat (g/100g) Total milk solids (% w/w)																	
	Comp.1	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ³	% Fail	۹ n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ³	% Fail4	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ³	% Fail⁴
Biscuits, cream cracker	1	5	≤4	2.7	2.9	2.3	0.2	Yes	Pass	0																		
Biscuits, plain, sweet	1	5	≤4	2.7	3.2	2.5	0.3	Yes	Pass	0																		
Biscuits, butter	1	5	≤4	2.4	2.4	2.2	0.1	Yes	Pass	0																		
Biscuits, crispbread	1	5	≤4	2.0	2.4	1.4	0.4	Yes	Pass	0																		
Muesli bar, apricot & coconut	1	5	NS ²	9.7	10.2	9.3	0.4	-	-	-																		
Muesli bar, forest fruits	1	5	NS ²	9.0	9.5	8.4	0.5	-	-	-																		
Muesli bar, tropical fruit	1	5	NS ²	9.2	9.7	8.5	0.5	-	-	-																		
Muesli mix, fruitful	1	5	NS ²	5.2	5.4	5.0	0.2	-	-	-																		
Muesli mix, natural	1	5	NS ²	9.3	9.6	9.0	0.2	-	-	-																		
Cheese, cheddar	1	5	≤45	44.7	48.9	43.5	2.3	No	Pass	20	5	≥45⁵	52.4	57.1	50.0	2.8	Yes	Pass	0									
Milk, condensed sweetened	1										5	≤9	8.9	9.0	8.7	0.1	No	Pass	0	5	≥31	27	28	25	1	Yes	Fail	100
Milk dried skim										10								_										
	1	5	≤4	5.1	5.2	4.9	0.1	Yes	Fail	0	5	≤1.25	0.84	0.90	0.70	0.09	Yes	Pass	0									
Fruit spread, raspberry	1	5	NS ²	32.4	32.8	32.1	0.3	-	-	-																		
Chocolate drink powder	1	5	≤4	0.72	0.8	0.7	0.04	Yes	Pass	0																		
Coffee, instant	1	5	≤4	5.7	5.9	5.6	0.1	Yes	Fail	10 0																		

Table E1 Results of moisture, fat and total milk solids compliance testing

¹ Number of packets combined to create sample size required for each replicate of testing

² NS=No Pass/Fail criteria specified in ADFFS (2008). CASG requested testing in anticipation of establishing future requirements.

³ Pass/Fail specification @ 95% confidence level.

⁴%Fail based on ADFFS specifications.

³Requirement and results reported on a dry weight basis (moisture free).

Table E2 R	esults of salt	and acidity	compliance	testing
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Component					Sá	alt (% w	/w)			Titratable acidity (% w/w)													Acidity	' (/mL Na	aOH)			
_	Comp. ¹	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³
Milk, dried, skim	1										5	≤0.15	0.12	0.12	0.12	0.00	No	Pass	0									
Vegetable extract	2	5	10-14	10	10	10	0	No	Pass	0																		
Sauce, BBQ	2																			5	19-21	1.72	1.80	1.70	0.04	Yes	Fail ⁵	100
Sauce, sweet chilli	2	5	0.8-1.4	1.3	1.3	1.3	0	No	Pass	0	5	NS ⁴	1.60	1.60	1.60	0.00	-	-	-									
Tomato ketchup	2										5	1.90-2.10	1.20	1.20	1.20	0.00	Yes	Fail	100									
Sauce, Worcestershire	2										5	2.5-3.8	2.88	3.00	2.80	0.08	No	Pass	0									

¹ Number of packets combined to create sample size required for each replicate of testing.

² Pass/Fail specification @ 95% confidence level.

⁴ NS=No Pass/Fail criteria specified in ADFFS (2008). CASG requested testing in anticipation of establishing future requirements.

³ Specification for BBQ sauce is incomplete. Assumed 0.1N NaOH used.



³%Fail based on ADFFS specifications.

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Table E3 Results of total solids, protein and total sugars compliance testing

Component	Comp.1				Tot	al solids	(% w/w	v)						Pro	tein (% v	v/w)							Total	sugars (g/100g)			
		n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³
Vegetable extract	2	5	≥63	61.4	62.3	60.6	0.6	Yes	Fail	100	5	≥19	23.4	24.8	22.6	0.9	Yes	Pass	0									
Chocolate drink powder	1																			5	≥77	83.0	83.5	81.9	0.6	Yes	Pass	0

¹ Number of packets combined to create sample size required for each replicate of testing.

² Pass/Fail specification @ 95% confidence level.

³%Fail based on ADFFS specifications.

Table E4 Results of total solids, protein and total sugars compliance testing

Component	Comp. ¹					Brix (de	grees)							Lactose m	nonohydra	te (g/kg)					Water	r insolubl	e resid	ue (g/	'100g)		
		n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ³	% Fail ⁴	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³
Cheese, cheddar	1										5	≤ 0.5	0.01	0.01	<0.01	0.00	Yes	Pass	0									
Fruit spread, raspberry	1	5	66-71	63.3	63.6	63.1	0.2	Yes	Fail	100																		
Coffee, instant	1																			5	≤0.3	1.7	3.2	0.4	1.2	Yes	Fail	100
Fruit grains, apricot	2	2	85-87	84.0	84.0	84.0	0.0	Yes	Fail	100																		
Fruit grains, raspberry	2	5	85-87		No res	sults pos	ssible ²																					
Fruit grains, mixed berry	2	5	85-87		No res	sults pos	ssible ²																					
Fruit grains, strawberry	2	5	85-87		No res	sults pos	ssible ²																					
Fruit grains, tropical	2	5	85-87	84.8	85.0	84.0	0.5	No	Pass	20																		
Sauce, BBQ	2	5	35-37	34.6	35.0	34.0	0.4	Yes	Fail	60																		
Sauce, sweet chilli	2	5	≥10	30.5	31.0	30.0	0.4	Yes	Pass	0																		
Tomato ketchup	2	5	≥34	26.9	27.3	26.4	0.4	Yes	Fail	100																		

¹ Number of packets combined to create sample size required for each replicate of testing.

² Samples were too opaque to obtain meaningful results.

³ Pass/Fail specification @ 95% confidence level.
 ⁴%Fail based on ADFFS specifications.

Table E5 Results of ash and extract soluble compliance testing

Component	Comp.1					Ash	′%w/w)							Alcohol	soluble	(g/100g	g)						Ether	soluble	(g/100g)	,		
		n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail³
Pepper, black	5	5	≤7	4.3	4.5	4.1	0.2	Yes	Pass	0	5	≥8	8.4	9.0	7.8	0.6	No	Pass	40	5	≥6	4.5	4.9	3.5	0.6	Yes	Fail	100
1 Number of packet	combined	to orc	nato camplo i	cizo roquir	d for oac	h ronlig	to of too	ling																				

of packets combined to create sample size required for each replicate of testing

² Pass/Fail specification @ 95% confidence level

³%Fail based on ADFFS specifications.

Appendix F: Results of Analysis for Microbiological Compliance to ADFFS

Company				Incub	ation/ste	ərility ²				Standard	plate cour	nt (CFU/g)						Filth	test		
Component	Comp. ¹	ADFFS			n=5			Pass/Fail	ADFFS		n	=5			Pass/Fail	ADFFS		n=	5		
Biscuits, cream cracker	2								NS ³ [≤10E3]	10est	10est	<10	<10	<10	Pass						
Biscuits, plain, sweet	2								NS ³ [≤10E3]	<10	10est	<10	<10	<10	Pass						
Biscuits, butter	2								NS ³ [≤10E3]	<10	<10	<10	<10	50est	Pass						
Biscuits, crispbread	2								NS ³ [≤10E3]	3200	920	2700	3000	110est	Fail						
Muesli bar, apricot & coconut	2								NS ³ [≤10E3]	240	230	350	200	220	Pass	NS ³	ND ⁴				
Muesli bar, forest fruits	2								NS ³ [≤10E3]	280	290	370	250	360	Pass	NS ³	ND ⁴				
Muesli bar, tropical fruit	2								NS ³ [≤10E3]	350	280	430	280	360	Pass	NS ³	ND ⁴				
Muesli mix, fruitful	1								NS ³ [≤10E3]	250	200	410	550	240	Pass	NS ³	ND ⁴				
Muesli mix, natural	1								NS ³ [≤10E3]	350	240	5500	680	1200	Fail	NS ³	ND ⁴				
Cheese, cheddar	1								NS ³ [≤10E2]	20est	40est	110est	30est	20est	Pass						
Milk, condensed sweetened	1	CS	CS ⁴	CS ⁴	CS ⁴			Pass	NS ³ [≤10E3]	280	450	390	290	340	Pass						
Milk, dried, skim	10								none > 2E5, nor >2 with >5E4	50est	10est	50est	10est	<10	Pass						
Pudding, fruit	1								NS ³	20est	50est	60est	90est	120est							
Pudding, chocolate	1								NS ³	110est	100est	110est	70est	130est							
Pudding, golden	1								NS ³	110est	250	100est	190	70est							
Fruit spread, raspberry	2								NS ³ [≤10E3]	<10	<10	<10	<10	<10	Pass						
Vegetable extract	2	CS	CS ⁴	CS ⁴	CS ⁴			Pass	NS ³	100	130est	150	100est	130est							
Chocolate drink powder	1								none > 1E5,nor>2 with 5E4	<10	40est	150	10est	<10	Pass						
Coffee, instant	10								NS ³ [≤10E3]	<10	<10	<10	<10	<10	Pass						
Fruit grains, apricot	3								NS ³	<10	<10	<10	<10	<10							
Fruit grains, raspberry	3								NS ³	150	200	200	280	140est							
Fruit grains, mixed berry	3								NS ³	<10	<10	<10	<10	<10							
Fruit grains, strawberry	3								NS ³	<10	<10	<10	<10	<10							
Fruit grains, tropical	3								NS ³	<10	<10	<10	<10	<10							
Sauce, BBQ	5	CS	CS	CS	CS	CS	CS	Pass	none >10E4	<10	<10	<10	<10	<10	Pass						
Sauce, sweet chilli	5	CS	CS	CS	CS	CS	CS	Pass	< 20	100est	120est	90est	150	140est	Fail						
I omato ketchup	5	CS	CS	CS	CS	CS	CS	Pass	NS ³	220	230	240	120est	260							
Sauce, Worcestershire	5	CS	CS ⁴	CS ⁴	CS ⁴			Pass	NS ³	10est	260	140est	340	30est							
Pepper, black	10								NS ³ [≤10E3]	20est	<10	<10	10est	<10	Pass						

Table F1 Results of commercial sterility, total viable aerobic count and filth compliance testing

¹ Number of packets combined to create sample size required for each replicate of testing.

² CS=Commercial sterility following incubation for 14 days @ 30-38 °C and 7 days @ 50-55 °C.

³ NS=No Pass/Fail criteria specified in ADFFS (2008). CASG requested testing in anticipation of establishing future requirements. Where Pass/Fail criteria have been specified in square parentheses, these have been derived from IFST (1999).

⁴ The external laboratory misunderstood the testing requirement. Rather that undertake 5 replicate analyses at three temperatures, they assumed 3 replicates was all that was required for the temperatures covered.

⁵ Not detected.

Component				Ye	asts (CF	U/g)					Ма	oulds (CF	:U/g)		
Component	Comp. ¹	ADFFS			n=5			Pass/Fail	ADFFS			n=5			Pass/Fail
Muesli bar, apricot & coconut	2	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Muesli bar, forest fruits	2	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Muesli bar, tropical fruit	2	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Muesli mix, fruitful	1	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	250	100	Fail
Muesli mix, natural	1	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Cheese, cheddar	1	NS ²	<100	<100	<100	<100	<100		NS ²	<100	<100	<100	<100	<100	
Milk, condensed sweetened	1	NS ²	<100	<100	<100	<100	<100		NS ²	<100	<100	<100	<100	<100	
Pudding, fruit	1	NS ²	<100	<100	<100	<100	<100		NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Pudding, chocolate	1	NS ²	<100	<100	<100	<100	<100		NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Pudding, golden	1	NS ²	<100	<100	<100	<100	<100		NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Fruit spread, raspberry	2	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Vegetable extract	2	NS ²	<100	<100	<100	<100	<100		NS ²	<100	<100	<100	<100	<100	
Sauce, BBQ	5	< 50	<100	<100	<100	<100	<100	Inconclusive ³	< 50	<100	<100	<100	<100	<100	Inconclusive ³
Sauce, sweet chilli	5	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	< 10	<100	<100	<100	<100	<100	Inconclusive ³
Tomato ketchup	5	<1	<100	<100	<100	<100	<100	Inconclusive ³	< 1	<100	<100	<100	<100	<100	Inconclusive ³
Sauce, Worcestershire	5	NS ² [≤10E3]	<100	<100	<100	<100	<100	Pass	NS ² [≤10E2]	<100	<100	<100	<100	<100	Pass
Pepper, black	10	NS ²	<100	<100	<100	<100	<100		NS ²	<100	<100	<100	<100	<100	

¹ number of packets combined to create sample size required for each replicate of testing ² NS=No Pass/Fail criteria specified in ADFFS (2008). CASG requested testing in anticipation of establishing future requirements. Where Pass/Fail criteria have been specified in square parentheses, these have been derived from IFST (1999). ³ Sensitivity of method used was not sufficient to determine compliance against ADFFS

Company		C	oliform	ns (MP	N/g)						Salm	nonella	(/25g)					E.c	oli (M	PN/g)		
Component	Comp. ¹	ADFFS			n=5			Pass/Fail	ADFFS ²			n=5			Pass/Fail	ADFFS			n=5			Pass/Fail
Milk, dried, skim	10	none > 50, nor >1 with >5	<3	<3	<3	<3	<3	Pass	ND ³	ND	ND	ND	ND	ND	Pass							
Fruit spread, raspberry	2								NS ⁴	ND	ND	ND	ND	ND	Pass							
Chocolate drink powder	1	none > 50, nor >1 with >5	<3	<3	4	<3	<3	Pass	ND	ND	ND	ND	ND	ND	Pass							
Sauce, BBQ	5								ND	ND	ND	ND	ND	ND	Pass	ND	<1	<1	<1	<1	<1	Pass
Pepper, black	10								ND	ND	ND	ND	ND	ND	Pass							

Table F3 Results of Coliforms, E.coli and salmonella compliance testing

¹ number of packets combined to create sample size required for each replicate of testing.

² ND = absent in 25 g sample.

³ ADFFS requires absence in 60 samples of 25 g sample. Only 5 samples were tested as costs are prohibitive. ⁴ NS=No Pass/Fail criteria specified in ADFFS (2008). CASG requested testing in anticipation of establishing future requirements. Where Pass/Fail criteria have been specified in square parentheses, these have been derived from IFST (1999).

Table F4 Results of Bacillus cereus, staphylococci and Enterobacteriaceae compliance testing

				B.c	ereus (C	FU/g)			Coagulase positive sta	phyloc	occi (/0	01g)					Enter	obacteri	iaceae C	Count (<	100g)	
Component	Comp. ¹	ADFFS			n=5			Pass/Fail	ADFFS			n=5			Pass/ Fail	ADFFS			n=5			Pass/ Fail
Milk, dried, skim	10								Absent in 0.1 g nor >1 with presence in 0.01 g	ND	ND	ND	ND	ND	Pass							
Chocolate drink powder	1								none > 100, nor >1 with >10	ND	ND	ND	ND	ND	Pass							
Sauce, BBQ	5	<100	<100	<100	<100	<100	<100	Pass								<100	<1 0	<10	<10	<10	<10	Pass

¹ number of packets combined to create sample size required for each replicate of testing.

² ND = absent in 25 g sample.

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Appendix G: Results of Analysis for Physical Compliance of Food to ADFFS

Component				N	et weight	(g)				-								
	n	ADFFS ¹	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³	_								
Biscuits, cream cracker	20	NS [35]	36.3	37.0	35.5	0.4	Yes	Pass	0									
Biscuits, plain, sweet	20	NS [36]	37.2	38.7	36.0	0.7	Yes	Pass	0									
Biscuits, butter	20	NS [35]	36.3	37.1	35.5	0.5	Yes	Pass	0									
Biscuits, crispbread	20	NS [40]	44.3	46.4	41.5	1.3	Yes	Pass	0									
Muesli bar, apricot & coconut	20	NS [31.25]	33.5	35.8	31.6	0.9	Yes	Pass	0									
Muesli bar, forest fruits	20	NS [31.25]	33.5	35.7	32.0	1.0	Yes	Pass	0									
Muesli bar, tropical fruit	20	NS [31.25]	34.0	36.0	32.3	0.8	Yes	Pass	0									
Muesli mix, fruitful	20	100	99.3	102.2	97.8	1.2	Yes	Fail	75									
Muesli mix, natural	20	100	102.5	107.9	98.4	3.0	Yes	Pass	20									
Cheese, cheddar	20	NS [56]	64.4	63.4	63.0	0.6	Yes	Pass	0				Scorche	d particles	; (Disc, /2	?5 g)		
Milk, condensed sweetened	20	≥71	85.6	86.5	84.6	0.4	Yes	Pass	0	n	ADFFS	Mean	Ma	x Min	SD	signif. 95%	P/F ²	% Fail ³
Milk, dried, skim	20	NS [3]	3.1	3.2	3.0	0.1	Yes	Pass	0	5	Disc At	А	А	А	-	No	Pass	0
Pudding, fruit	20	NS [350]	355.4	363.9	350.8	2.8	Yes	Pass	0									
Pudding, chocolate	20	NS [300]	313.2	321.4	301.9	4.5	Yes	Pass	0									
Pudding, golden	20	NS [300]	316.5	329.5	311.0	4.6	Yes	Pass	0									
Fruit spread, raspberry	20	NS [26]	26.3	26.7	25.5	0.3	Yes	Pass	5									
Vegetable extract	20	≥15	15.4	15.8	14.9	0.2	Yes	Pass	5									
Chocolate drink powder	20	≥40	43.2	44.6	42.4	0.6	Yes	Pass	0									
Coffee, instant	20	3.5	3.7	3.8	3.6	0.1	Yes	Pass	0									
Fruit grains, apricot	20	15	16.2	17.6	14.6	0.9	Yes	Pass	10									
Fruit grains, raspberry	20	15	16.2	18.3	14.8	0.9	Yes	Pass	5									
Fruit grains, mixed berry	20	15	16.1	18.9	14.2	1.1	Yes	Pass	10									
Fruit grains, strawberry	20	15	18.9	29.5	16.0	3.3	Yes	Pass	0					pН				
Fruit grains, tropical	20	15	17.2	19.6	15.9	1.0	Yes	Pass	0	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³
Sauce, BBQ	9	NS [10]	9.7	9.7	9.6	0.0	Yes	Fail	100	5	3.9-4.2	4.04	4.05	4.03	0.01	Yes	Pass	0
Sauce, sweet chilli	9	≥10	10.2	10.3	10.0	0.1	Yes	Pass	0	5	3.6-3.9	3.15	3.16	3.13	0.01	Yes	Fail	100
Tomato ketchup	11	≥15	15.2	15.2	15.1	0.1	Yes	Pass	0	5	3.15-3.45	3.91	3.91	3.91	0.00	Yes	Fail	100
Sauce, Worcestershire	18	NS [10]	9.3	10.2	8.4	0.7	Yes	Fail	67									<u> </u>
Penner black	20	>2	21	23	10	0.1	Voc	Dace	5									

Table G1 Results of net weight, scorched particles and pH compliance testing

 Pepper, black
 20
 ≥2
 2.1
 2.3
 1.9
 0.1
 Yes
 Pass
 5

 ¹ NS - where no Pass/Fail criteria are specified in ADFFS (2008) specified, labelling net weight claims have been used and cited in square parentheses.

² Pass/Fail specification @ 95% confidence level.

² %Fail based on ADFFS specifications. Where these are not specified manufacturer claims are used.

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Component				V	Vater cct	tivity						Phy	sical dime	ensions	(mm)				
	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ¹	% Fail ²	Dimension (mm)	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ¹	% Fail²
Fruit grains, apricot	5	≥0.5	0.40	0.41	0.39	0.01	Yes	Fail	100	Length	100	12-14	9	15	3	3	Yes	Fail	91
										Width	100	9-11	8	10	3	2	Yes	Fail	19
										Depth	100	4-5	4	4	2	0	Yes	Pass	9
Fruit grains, raspberry	5	≥0.5	0.40	0.41	0.40	0.00	Yes	Fail	100	Length	100	12-14	12	14	9	1	No	Pass	33
										Width	100	9-11	9	10	6	1	No	Pass	12
										Depth	100	4-5	4	5	2	0	Yes	Pass	13
Fruit grains, mixed berry	5	≥0.5	0.47	0.47	0.46	0.01	Yes	Fail	100	Length	100	12-14	12	19	8	1	Yes	Fail	51
										Width	100	9-11	9	10	4	1	Yes	Pass	10
										Depth	100	4-5	4	4	3	0	No	Pass	2
Fruit grains, strawberry	5	≥0.5	0.40	0.40	0.40	0.00	Yes	Fail	100	Length	100	12-14	11	19	6	1	Yes	Fail	59
										Width	100	9-11	9	9	8	0	Yes	Pass	5
										Depth	100	4-5	4	4	2	0	Yes	Pass	12
Fruit grains, tropical	5	≥0.5	0.47	0.47	0.46	0.01	Yes	Fail	100	Length	100	12-14	10	13	4	2	Yes	Fail	76
										Width	100	9-11	9	10	3	1	Yes	Pass	14
										Depth	100	4-5	4	5	2	0	Yes	Pass	14

Table G2 Results of water activity and grain size (physical dimensions) compliance testing

¹ Pass/Fail based on whether or not >50% of results were outside the ADFFS requirement

2%Fail based on ADFFS specifications.

Table G3 Results of headspace and particulate residue compliance testing

Component				He	adspa	ce (mm)							Part	iculate i	residue	(g)		
	n ¹	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ³	% Fail	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ⁴	% Fail⁵
Pudding, fruit	40	NS ²	15	24	9	5	Yes	Fail	65									
Pudding, chocolate	40	NS ²	17	27	6	5	Yes	Fail	100									
Pudding, golden	40	NS ²	15	26	6	4	Yes	Fail	100									
Sauce, Worcestershire										20	0	0.6	3.7	0.0	0.8	Yes	Fail	85

¹ Each of 20 cans had a reading taken from the centre of the can and the edge of the can. ² NS=Not Specified in ADFFS 2008 Edition

³ Pass/Fail criteria set at headspace no greater than 10 mm.

⁴ Pass/Fail specification @ 95% confidence level.
 ⁵% Fail based on ADFFS specification.

Appendix H: Results of Analysis for **Physical Compliance of Packaging to ADFFS**

Table H1 Results of physical (packaging) dimensions compliance testing

Component				Pa	ckage dir	nensions	: (mm)			
Component	Dimension	n	ADEES	Mean	Max	Min	SD.	signif 95%	P/F4	% Fail ⁵
Biscuits cream cracker	Width	20	NS1	95	97	94	1	olgrin. 0070	171	70 T dil
	Length	20	NS1	144	146	142	1			
Biscuits plain sweet	Width	20	NS ¹	70	71	70	0			
Diodato, plant, offoot	Length	20	NS1	138	141	135	2			
Biscuits butter	Width	20	NG1	61	62	60	1			
	Longth	20	NC1	136	137	133	י כ			
Bisquits crisphread	Width	20	NG1	77	80	64	2			
Discuits, crisporeau	VVICUI	20	NO1	110	152	146	4			
Mucali har anriant 8 acconut	Length	20	NO1	149	100	140	2			
Muesil bal, apricol & cocorrul	Lengin	20	NO1	129	40	120	1			
Mussliker forset fruits	vviatri	20	NO1	40	49	47	1			
Muesil bar, lorest fruits	Length	20	NS ¹	129	133	123	2			
Mussli har tranical fruit	vviatn	20	NS ¹	48	49	48	0			
Muesil bar, tropical fruit	Length	20	NS ¹	128	130	125	1			
Marcall and a facility I	vviath	20	NS ¹	49	49	48	1			
Muesii mix, fruittui	Height	20	NS	123	123	122	1			
	Width	20	NS	1/0	1/1	169	1			
Muesli mix, natural	Height	20	NS ¹	123	124	121	1			
.	Width	20	NS ¹	171	171	169	1			
Cheese, cheddar	Diameter	20	NS ¹	51	52	51	1			
	Height	20	NS ¹	33	34	33	0			
Milk, condensed sweetened	Length	20	NS ¹	132	133	131	1			
	Width	20	NS ¹	43	43	43	0			
Milk, dried, skim	Length	20	NS ¹	79	80	77	1			
	Width	20	NS ¹	62	62	62	0			
Pudding, fruit	Diameter	20	NS ¹	98	98	97	0			
	Height	20	NS ¹	68	68	67	0			
Pudding, chocolate	Diameter	20	NS ¹	98	98	97	0			
	Height	20	NS ¹	68	68	68	0			
Pudding, golden	Diameter	20	NS ¹	98	98	98	0			
	Height	20	NS ¹	68	68	68	0			
Fruit spread, raspberry	Length	20	NS ¹	103	103	103	0			
	Width	20	NS ¹	29	29	29	0			
Vegetable extract	Length	20	NS ¹	73	74	72	1			
	Width	20	NS ¹	29	29	29	0			
Chocolate drink powder	Height	20	125 ²	126	127	125	1	Yes	Pass	0
	Width	20	85 ²	86	87	85	1	Yes	Pass	0
Coffee, instant	Width	20	40 ²	107	108	106	1	Yes	Pass	0
	Height	20	110 ²	43	45	41	1	Yes	Pass	0
Fruit grains, apricot	Height	20	75 ³	95	96	92	1	Yes	Fail	100
	Width	20	105 ³	85	85	85	0	Yes	Fail	100
Fruit grains, raspberry	Height	20	75 ³	94	96	92	1	Yes	Fail	100
	Width	20	105 ³	85	86	84	1	Yes	Fail	100
Fruit grains, mixed berry	Height	20	75 ³	94	96	92	1	Yes	Fail	100
ů i j	Width	20	105 ³	85	85	85	0	Yes	Fail	100
Fruit grains, strawberry	Height	20	75 ³	94	97	91	1	Yes	Fail	100
C · · · ·	Width	20	105 ³	84	85	84	0	Yes	Fail	100
Fruit grains, tropical	Height	20	75 ³	95	97	93	1	Yes	Fail	100
0 / 1	Width	20	105 ³	86	87	86	0	Yes	Fail	100
Sauce. BBQ	Width	20	NS ¹	51	52	51	0			
	Height	20	NS ¹	95	95	94	0			
Sauce, sweet chilli	Width	20	40 ³	52	52	51	0	Yes	Fail	100
	Height	20	903	83	84	83	õ	Yes	Fail	100
Tomato ketchup	Width	20	40 ³	52	52	51	0 0	Yes	Fail	100
	Height	20	903	94	94	93	1	Yes	Pass	0
Sauce Worcestershire	Width	20	NS ¹	51	51	50	0		1 000	v
	Height	20	NS1	85	85	83	1			
Pepper black	Height	20	552	39	42	38	1	Yes	Fail	100
	Width	20	322	53	54	52	1	Yes	Pass	0

¹ NS No Pass/Fail criteria specified in ADFFS (2008). Requirement is "those specified in the Standing Offer/Contract". These are unknown to DST Group ² Internal dimensions specified in the product specification.

³ External dimensions specified in the product specification.
 ⁴ Pass/Fail specification @ 95% confidence level.
 ^{5%} Fail based on ADFFS specification.

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Table H2 Results of seal width and presence/placement of tear notch compliance testing

Component		Width	n (mm)								Pre	sence and p	lacement of tear notches			
	Seal ¹	n	ADFFS ¹	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³	n	ADFFS	location	P/F	Residual seal width	P/F
Biscuits, cream cracker	Top/bottom	40	≥8	15.6	19	13	1.1	Yes	Pass	0	20	Present	Absent	Fail		
Picquita plain awaat	Back fin	20	≥8 >5	7.0	9 17	5	0.9	Yes	Fail	90	20	Drocont	Abaant	Foil		
Discuits, plain, sweet	Back fin	20	≥0 >8	7 1	8	7	0.7	Yes	Fass	95	20	Flesen	Absem	Fall		
Biscuits butter	Top/bottom	40	=0 ≥5	14.8	16	13	0.2	Yes	Pass	0	20	Present	Absent	Fail		
	Back fin	20	≥8	7.1	8	7	0.3	Yes	Fail	90						
Biscuits, crispbread	Top/bottom	40	≥5	13.7	15	10	1.3	Yes	Pass	0	20	Present	Absent	Fail		
	Back fin	20	≥8	11.6	14	8	1.7	Yes	Pass	0						
Muesli bar, apricot & coconut	Top/bottom	40	≥5	12.5	15	11	1.4	Yes	Pass	0	20	Present	Absent	Fail		
	Back fin	20	≥8	12.6	14	12	0.6	Yes	Pass	0		_				
Muesli bar, forest fruits	Top/bottom	40	≥5	12.1	13	10	0.9	Yes	Pass	0	20	Present	Absent	Fail		
	_Back fin	20	≥8	11.4	12	11	0.5	Yes	Pass	0		_				
Muesli bar, tropical fruit	Top/bottom	40	≥5	13.3	14	12	0.5	Yes	Pass	0	20	Present	Absent	Fail		
	_Back fin	20	≥8	12.8	13	12	0.4	Yes	Pass	0	00	-				
Muesli mix, fruitful	l op/bottom	40	≥8	10.5	18	(3.1	Yes	Pass	30	20	Present	Bottom seal, right side, 1 of	Pass	> 5 mm	Pass
	Side	40	≥8	7.9	9	1	0.6	NO	Fail	25	00	D (AL .			
Muesli mix, natural	l op/bottom	40	≥8 >0	8.3	10	6	1.1	Yes	Pass	25	20	Present	Absent	Fail		
Mills date al size	Side	40	≥ŏ >r	0.0	/	0	0.4	res	Fall	100	20	Dessert	Cide and 17 mm from ton 1 of	Dees	< 2 mm	F -3
Milk, ariea, skim	Top/bottom	40	≥5 >r	0.0	Ö	3	1.0	res	Pass	8	20	Present	Side seal, 17 mm from top, 1 of	Pass	< 3 mm	Fall
Chapalata drink nowdar	Side	20	≥5 \\0	1.4	20	17	0.5	res	Pass	0	20	Drocont	Abcont	Foil		
Chocolate driftk powder	Top Side	20	<0 ∖0	10.0	20	17	1.0	Yes	Fass	10	20	Present	Absent	Fall		
Coffee instant	Jue Ton/hottom	40	≥0 >5	1.1	9	1	0.0	Vee	Fall	40	20	Drocont	Side and 6 mm from top, both sides	Dooo	< 2 mm	Foil
Collee, Instant	Sido	40	20	4.0	5 1	4	0.5	Yes	Fall	40	20	Present	Side seal, 6 mm nom top, both sides	Pass	< 3 mm	Fall
Fruit grains apricot	Ton/bottom	40	20 >8	13.1	11	15	0.7	Ves	Pass	0	20	Procont	Top seal right side 1 of	Dace	> 5 mm	Dace
Truit grains, apricot	Back fin	20	≥0 >5	63	7	5	0.0	Ves	Dace	0	20	riesent	Top seal, fight side, Tor	1 033	2 3 11111	1 855
Fruit grains, raspherry	Ton/hottom	40	>8	14.0	16	10	12	Yes	Pass	0	20	Present	Top seal right side 1 of	Pass	> 5 mm	Pass
That grains, raspoony	Back fin	20	=0 >5	6.5	8	5	0.8	Yes	Pass	Ő	20	Trosont	Top seal, fight side, T of	1 433	× 0 mm	1 035
Fruit grains, mixed berry	Ton/hottom	40	>8	15.8	19	14	14	Yes	Pass	Ő	20	Present	Top seal right side 1 of	Pass	> 5 mm	Pass
That grains, mixed berry	Back fin	20	_0 ≥5	7.2	9	6	0.8	Yes	Pass	õ	20	ricoom		1 400	, O min	1 400
Fruit grains strawberry	Top/bottom	40	_0 ≥8	15.5	17	10	17	Yes	Pass	õ	20	Present	Top seal right side 1 of	Pass	> 5 mm	Pass
rat grano, or anothy	Back fin	20	_0 ≥5	8.5	10	6	11	Yes	Pass	õ	20	riooont		1 400	· · ·	1 400
Fruit grains, tropical	Top/bottom	40	_0 ≥8	15.1	19	11	1.7	Yes	Pass	õ	20	Present	Top seal, right side, 1 of	Pass	> 5 mm	Pass
· · · · · · · · · · · · · · · · · · ·	Back fin	20	≥5	9.8	12	8	1.0	Yes	Pass	Ō			· · · · · · · · · · · · · · · · · · ·			
Sauce, BBQ	Top/bottom	40	≥5	5.8	7	4	0.5	Yes	Pass	3	20	Present	Side seal. 8 mm from top. 2 of	Pass	< 3 mm	Fail
,	Side	40	≥8	4.1	5	3	0.5	Yes	Fail	100					-	
Sauce, sweet chilli	Top/bottom	40	≥5	5.3	6	4	0.6	Yes	Pass	5	20	Present	Side seal, 8 mm from top, 2 of	Pass	< 3 mm	Fail
-	Side	40	≥5	4.1	5	3	0.5	Yes	Fail	85			· · · ·			
Tomato ketchup	Top/bottom	40	≥5	6.2	7	5	0.4	Yes	Pass	0	20	Present	Side seal, 8 mm from top, 2 of	Pass	< 3 mm	Fail
•	Side	40	≥8	4.6	7	3	1.0	Yes	Fail	100			-			
Sauce, Worcestershire	Top/bottom	40	≥5	5.0	6	3	0.8	No	Pass	30	20	Present	Side seal, 8 mm from top, 2 of	Pass	< 3 mm	Fail
	Side	40	≥5	6.3	7	5	0.4	Yes	Pass	0			-			
Pepper, black	Тор	20	≥5	6.5	9	4	1.0	Yes	Pass	3	20	Present	Top seal, right side, 1 of	Pass	> 5 mm	Pass
	Side	40	≥5	9.3	10	8	0.6	Yes	Pass	0						

1 Seals ≤80 mm in length require seal width no less than 5 mm. Seals >80 mm in length require seal width no less than 8 mm. ² Pass/Fail specification @ 95% confidence level. ^{3%} Fail based on ADFFS specification.

Table H3 Results of thread diameter (of tubes) compliance testing

Component			Thread			
	n	ADFFS	Max	Min	P/F ¹	% Fail²
Milk, condensed sweetened	20	7	11	10	Fail	100
Fruit spread, raspberry	20	7	7	7	Pass	0
Vegetable extract	20	7	7	7	Pass	0

¹ Pass/Fail specification @ 95% confidence level. ²%Fail based on ADFFS specifications.

Table H4 Results of gauge pressure and O₂ in headspace content

Component				Ga	uge pres			O ₂ con	itent in he	adspace	e (%)				
	n	ADFFS	Mean	Max	Min	SD	signif. 95%	P/F ¹	% Fail ²	n	ADFFS	Mean	Max	Min	SD
Biscuits, crispbread										20	NS ³	20.4	21.5	18.7	0.8
Muesli mix, fruitful										20	NS ³	13.4	19.5	8.7	3.4
Muesli mix, natural										20	NS ³	9.8	21.0	2.9	7.6
Milk, dried, skim										20	NS ³	20.1	20.8	19.8	0.2
Pudding, fruit	20	≤ -17	-62.1	0	-85.1	27.3	Yes	Pass	15						
Pudding, chocolate	20	≤ -17	-75.8	-6.8	-86.7	20.1	Yes	Pass	5						
Pudding, golden	20	≤ -17	-67.0	-39.0	-86.7	17.3	Yes	Pass	0						
Chocolate drink powder										20	NS ³	20.3	20.8	19.5	0.3
Coffee, instant										20	NS ³	19.9	20.9	17.1	1.0
Pepper, black										20	NS ³	20.2	20.8	19.7	0.3

¹ Pass/Fail specification @ 95% confidence level

^{2%}Fail based on ADFFS specification. ³NS=Not Specified in ADFFS 2008 Edition

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Appendix I: Results of Visual Inspections-Labelling Compliance to ADFFS

Table I1 Results of compliance to ADFFS 15-2-2 and FSANZ Standard 1.2 (general)

Component	Ingredient	Logibility	Preparation	Unit	Country	Batch	Manufacturer	Ingredients listing [*]
Component	listing	Legionity	instructions	quantity	of origin	code	details	
Biscuits, cream cracker	Present	Pass	-	Present	Present	Present	Present	
Biscuits, plain, sweet	Present	Pass	-	Present	Present	Present	Present	
Biscuits, butter	Present	Pass	-	Present	Present	Present	Present	
Biscuits, crispbread	Present	Pass	-	Present	Present	Present	Present	
Muesli bar, apricot & coconut	Present	Pass	-	Present	Present	Present	Present	
Muesli bar, forest fruits	Present	Pass	-	Present	Present	Present	Present	
Muesli bar, tropical fruit	Present	Pass	-	Present	Present	Present	Present	
Muesli mix, fruitful	Present	Pass	-	Present	Present	Present	Present	Dellade the first (divid encourse strength and a second encourse black) have some wheet have descended when
Muesli mix, natural	Present	Pass	-	Present	Present	Present	Present	Rolled oats, truit (dried papaya, pineapple, apple, apricot and pear, raisins, peach silces), brown sugar, wheat brand, pumpkin seeds, whey powder, flaked wheat, preservative (220)
Cheese, cheddar	Present	Pass	-	Present	Present	Present	Present	
Milk, condensed sweetened	Present	Pass	2	Present	Present	Present	Present	
Milk, dried, skim	Present	Pass	Recommend ⁻	Present	Present	Present	Present	
Pudding, fruit	Present	Pass	Present	Present	Present	Present	Present	Mixed truit (28%) [currants, suitanas, glace citrus peel (citrus peel, sugar, preservative (202), 220)]], water, wheat flour, sugar, shortening [vegetable fats and oils, antioxidant (307), emulsifier (soy lecithin)], egg, breadcrumbs, milk solids, salt, colour (150c), raising agents (450, 500), flavour
Pudding, chocolate	Present	Pass	Present	Present	Present	Present	Present	Glucose syrup, Flour, water, sugar, whole egg, shortening (vegetable fats & oils, antioxidant(322, 307), cocoa powder(2.2%), whey powder, thickener(1414), raising agents, (450,500,341), Vegetable gums (406, 466, 415), Flavours, salt, emulsifiers (471, 475)
Pudding, golden	Present	Pass	Present	Present	Present	Present	Present	Glucose syrup, flour, water, golden syrup (13.4%), sugar, whole egg, shortening [vegetable fats and oils, antioxidant (322, 307)] whey powder, thickener (1414), raising agents (450, 500, 431), vegetable gums (406, 466, 415), flavour, salt, emulsifiers(471, 475).
Fruit spread, raspberry	Present	Pass	-	Present	Present	Present	Present	
Vegetable extract	Present	Pass	-	Present	Present	Present	Present	Yeast extract, salt, mineral salt (508), malt extract (from barley), natural colour (150d) (contains preservative 220), vegetable extract, niacin, thiamine, riboflavin, folate, contains gluten and sulphite.
Chocolate drink powder	Present	Pass	Present	Present	Present	Present	Fail ³	
Coffee, instant	Exempt	Pass	-	Present	Present	Present	Present	
Fruit grains, apricot	Present	Pass	-	Present	Present	Present	Present	
Fruit grains, raspberry	Present	Pass	-	Present	Present	Present	Present	Concentrated fruit puree (raspberry (25%), apple (25%), pears(10%), and plum (6%), elderberry juice concentrate (5%), invert sugar, sugar, glycerol, wheat fibre, vegetable fat, pectin, citric acid (E330), flavour
Fruit grains, mixed berry	Present	Pass	-	Present	Present	Present	Present	Concentrated fruit puree: (apple(46%), strawberry(4.4%), plum(3%), and blueberry(1.2%)), juice concentrate: (elderberry (1.7%) and raspberry (0.6%), invert sugar, sugar, glycerol, dextrose, wheat fibre, malic acid (E296), tri-potassium citrate (E332), pectin, flavour.
Fruit grains, strawberry	Present	Pass	-	Present	Present	Present	Present	
Fruit grains, tropical	Present	Pass	-	Present	Present	Present	Present	
Sauce, BBQ	Present	Pass	-	Present	Present	Present	Present	
Sauce, sweet chilli	Present	Pass	-	Present	Present	Present	Present	
Tomato ketchup	Present	Pass	-	Present	Present	Present	Present	Water, tomato paste (20%), sugar, blend of selected spices, thickeners (E1442, E415), food acid (E260), salt, acidity regulator (E325), preservatives (E202, E211)
Sauce, Worcestershire	Present	Pass	-	Present	Present	Present	Present	
Pepper, black	Exempt	Pass	-	Present	Present	Present	Present	

¹ Exempt IAW FSANZ Standard 1.2.4

² ADFFS does not require directions for preparation

³ Information did not include details of business Address

⁴ Information provided to support non-compliant labelling issues identified in Section 3.2.4.

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Table I2 Results of compliance to ADFFS 15-2-2 and FSANZ Standard 1.2.3

	Mandatory declarations of certain food (Clause 4) – (Red text designates an incorrect declaration)													
Component	Cereals containing gluten and their products	Crustacea and their products	Egg and egg products	Fish and fish products	Milk and milk products	Peanuts and soyabeans and their products	Added sulphites (10 mg/kg or more)	Tree nuts and sesame seeds and their products	Polyols and polydextrose					
Biscuits, cream cracker	Yes	No	Yes	No	Yes	Yes	No	Yes	No					
Biscuits, plain, sweet	Yes	No	Yes	No	Yes	Yes	No	Yes	No					
Biscuits, butter	Yes	No	Yes	No	Yes	Yes	No	Yes	No					
Biscuits, crispbread	Yes	No	Yes	No	Yes	Yes	No	Yes	No					
Muesli bar, apricot & coconut	Yes	No	No	No	Yes	Yes	Yes	Yes	No					
Muesli bar, forest fruits	Yes	No	No	No	Yes	Yes	Yes	Yes	No					
Muesli bar, tropical fruit	Yes	No	No	No	Yes	Yes	Yes	Yes	No					
Muesli mix, fruitful	Yes	No	No	No	Yes	Yes	Yes	Yes	No					
Muesli mix, natural	No	No	No	No	No	Yes	No	Yes	No					
Cheese, cheddar	No	No	No	No	Yes	No	No	No	No					
Milk, condensed sweetened	No	No	No	No	Yes	No	No	No	No					
Milk, dried, skim	No	No	No	No	No ¹	No	No	No	No					
Pudding, fruit	No	No	No	No	No	Yes	No	Yes	No					
Pudding, chocolate	No	No	No	No	No	No	No	No	No					
Pudding, golden	No	No	No	No	No	No	No	No	No					
Fruit spread, raspberry	No	No	No	No	No	No	No	No	No					
Vegetable extract	Yes	No	No	No	No	No	Yes	No	No					
Chocolate drink powder	Yes	No	Yes	No	Yes	Yes	No	Yes	No					
Coffee, instant	No	No	No	No	No	No	No	No	No					
Fruit grains, apricot	No	No	No	No	No	No	No	No	No					
Fruit grains, raspberry	Yes	No	No	No	No	No	No	No	No					
Fruit grains, mixed berry	Yes	No	No	No	No	No	No	No	No					
Fruit grains, strawberry	Yes	No	No	No	No	No	No	No	No					
Fruit grains, tropical	Yes	No	No	No	No	No	No	No	No					
Sauce, BBQ	No	No	No	No	No	No	No	No	No					
Sauce, sweet chilli	No	No	No	No	No	No	No	No	No					
Tomato ketchup	No	No	No	No	No	No	No	No	No					
Sauce, Worcestershire	Yes	No	No	Yes	Yes	No	No	No	No					
Pepper, black	No	No	No	No	No	No	No	No	No					

¹ Product name is the ingredient.

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Table I3 Results of compliance to ADFFS 15-2-2 and FSANZ Standard 1.2.8

			Nutritional in	formation pan	el (per 100 g)			Serving size/ Nutritional information panel (per serve)								
Component	Energy (kJ)	Protein (g)	Fat - total (g)	Fat-sat (g)	CHO -total (g)	sugars (g)	sodium (mg)	# serves specified	Energy (kJ)	Protein (g)	Fat - total (g)	Fat-sat (g)	CHO-total (g)	sugars (g)	sodium (mg)	
Biscuits, cream cracker	1900	12	16.8	6.2	62.1	0.5	750	1	665	4.2	5.8	2.1	21.7	0.2	262	
Biscuits, plain, sweet	1833	5.9	13.6	6.6	71.2	29.3	334.0	1	600.0	2.1	4.9	2.4	25.6	10.5	120.0	
Biscuits, butter	2047	6.6	21.5	12.4	69.1	18.4	505	1	716	2.3	7.5	4.3	24.1	6.4	177	
Biscuits, crispbread	1630	11.2	7.2	1.0	64.0	1.8	490.0	1	652.0	4.4	2.9	0.4	25.6	0.7	196.0	
Muesli bar, apricot & coconut	1590	6.8	8.8	2.4	64.9	15.5	9	1	509	2.2	2.8	0.8	20.8	5	3	
Muesli bar, forest fruits	1600	6.7	8.8	2.4	65.9	16.3	9	1	513	2.1	2.8	0.8	21.1	5.2	3	
Muesli bar, tropical fruit	1610	6.7	8.8	2.4	65.7	14.4	8	1	514	2.1	2.8	0.8	21	4.6	3	
Muesli mix, fruitful	1550	10.2	9.2	1.9	57.5	16.2	571	1	1550	10.2	9.2	1.9	57.5	16.2	571	
Muesli mix, natural	1555	9	7	1	62	18	152	1	1555	9	7	1	62	18	152	
Cheese, cheddar	1280	19	24	17	4.9	<1	1470	1	723	11	13	9	3	<0.1	830	
Milk, condensed sweetened	Fail	1	1170	7.5	6.9	4.7	47.1	47.1	85							
Milk, dried, skim	Fail	Fail [±]	Fail	Fail	Fail [±]	Fail ¹	Fail ¹	1	5	0.1	0	0	0.1	0.1	1.4	
Pudding, fruit	1173	3.5	8.5	4.1	46.5	28	257	4	1026	3.1	7.4	3.6	40.7	24.5	225	
Pudding, chocolate	1263	3.3	8.2	3.8	53	30	255	4	947	2.5	6.2	2.9	39.8	22.5	191	
Pudding, golden	1263	3.3	8.2	3.8	53	30	255	4	947	2.5	6.2	2.9	39.8	22.5	191	
Fruit spread, raspberry	Fail	1	294	0.1	0.03	0	17.4	17.2	0.6							
Vegetable extract	Fail	1	122	3.8	<1	<1	2.9	0.3	507							
Chocolate drink powder	Fail	1	668	1.6	1.12	0.72	36.36	32.28	8							
Coffee, instant	Exempt ²	Exempt ²	Exempt ²	Exempt ²	Exempt ²	Exempt ²	Exempt ²	Exempt ²								
Fruit grains, apricot	1528	0.9	1.7	0.7	70.5	65.5	16	1	229	0.1	0.3	0.1	10.6	9.8	2	
Fruit grains, raspberry	Fail	1	231	0.1	0.3	0.1	10.5	9.8	2.1							
Fruit grains, mixed berry	Fail	1	227	0.1	0.05	0.02	11.4	10.8	1.8							
Fruit grains, strawberry	Fail	1	231	0.1	0.3	0.2	10.5	9.8	1.5							
Fruit grains, tropical	1568	0.9	1.8	0.8	77.1	73.4	14	1	235	0.1	0.3	0.1	11.6	11	2	
Sauce, BBQ	Fail	1	37	0.1	<0.1	<0.1	2.8	2.5	317							
Sauce, sweet chilli	Fail	1	37	0.1	0.02	<0.1	2.5	1.9	42							
Tomato ketchup	Fail	1	79	0.2	0.5	0.1	3.6	2.6	107							
Sauce, WWorcestershire	Fail	1	39	0.1	0.01	0	2.2	1.5	110							
Pepper, black	Exempt ³	Exempt	Exempt [°]	Exempt	Exempt	Exempt ³	Exempt	Exempt ³	Exempt ³	Exempt ³	Exempt ³	Exempt ³	Exempt ³	Exempt ³	Exempt ³	

Information not provided for 100g.
 Exempt according to FSC 1.2.8, Division 2, Clause 3(f).
 Exempt according to FSC 1.2.8, Division 2, Clause 3(j). 3 Inner package with surface area <30 cm².

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Appendix J: Results of Analysis for Sensory Compliance

Table J1 Results of sensory compliance testing

Component				0_00	int Hodor	nic retina	resulte			
Component	Attributo	r		9-p0 Maaa	Mex	no raurig Mi∽	150011S	aignif 05%	D/F?	0/ Ea:13
Risquite, groam grocker	Annoule	() F	AUFF5'	iviean	iviax o	IVIII)	3U 0.0	SIGUIT. 95%	P/F ²	70 Fall ³
Biscuits, cream cracker	Aroma	5 E	NS NC	1.Z 7.4	ð o	0	0.0	INO Xee	Pass	20
	Appearance	5 E	NC	7.4	0	7	0.0	Yes	Pass	0
	Texture	5	NS	7.Z	0	7	0.4	Yes	Pass	0
Risquite plain swoot	Aromo	5	NC	1.2	0	1	0.4	res	Pass	40
Biscuits, plain, sweet	Aroma	5	NO	0.0	0	0	0.0	NO	Fass Deee	40
	Appearance	5 7	NO	7.0	ð	0	0.7	NO No	Pass	20
	Texture	5	NO NC	7.0	ð	0	0.7	INO	Pass	20
Dissuits hutter	Flavour	5	ING NC	7.4	8	1	0.5	Yes	Pass	0
Biscuits, butter	Aroma	5	INS NC	7.4	8	7	0.5	Yes	Pass	0
	Appearance	5	NS NC	7.4	8	1	0.5	Yes	Pass	0
	Texture	5	INS NC	7.2	8	5	1.3	NO	Pass	20
D 's suite and subscrad	Flavour	5	NS NC	7.8	8	1	0.4	Yes	Pass	0
Biscuits, crispbread	Aroma	5	NS NC	7.4	8	6	0.9	Yes	Pass	20
	Appearance	5	NS	7.6	8	[0.5	Yes	Pass	0
	lexture	5	NS	7.6	8	1	0.5	Yes	Pass	0
	Flavour	5	NS	7.8	8	[0.4	Yes	Pass	0
Muesli bar, apricot & coconut	Aroma	5	NS	7.2	8	1	0.4	Yes	Pass	0
	Appearance	5	NS	6.4	8	5	1.1	No	Pass	60
	Texture	5	NS	6.6	8	6	0.9	No	Pass	60
	Flavour	5	NS	6.6	8	5	1.1	No	Pass	40
Muesli bar, forest fruits	Aroma	5	NS	6.4	8	5	1.3	No	Pass	40
	Appearance	5	NS	6.0	8	5	1.2	No	Pass	80
	Texture	5	NS	6.4	8	5	1.1	No	Pass	60
	Flavour	5	NS	6.2	8	5	1.1	No	Pass	80
Muesli bar, tropical fruit	Aroma	5	NS	6.8	8	5	1.3	No	Pass	40
	Appearance	5	NS	6.6	8	6	0.9	No	Pass	60
	Texture	5	NS	6.8	8	6	0.8	No	Pass	40
	Flavour	5	NS	7.0	8	6	1.0	No	Pass	40
Muesli mix, fruitful	Aroma (dry)	5	NS	7.6	8	7	0.5	Yes	Pass	0
	Appearance	5	NS	7.0	8	6	0.7	No	Pass	20
	(ury) Toxturo (dru)	5	NS	70	Q	7	0.4	Voc	Pass	0
	Flavour (dry)	5	NS	7.4	0 Q	7	0.4	Vos	Dass	0
	Aroma	5	NS	6.8	0 Q	5	13	No	Dass	40
	Toxturo	5	NS	0.0	0	7	0.5	Voc	Dace	40
	Flovour	5	NS	7.0	0	7	0.5	Ves	Pass	0
Muccli mix natural		5	NS	7.4	0	/ E	1.0	Ne	Pass	20
wuesii mix, naturai	Aroma (ury)	5	NO	1.2	0	Э	1.5	NO	F 855	20
	Appearance (dry)	5	NS	7.0	8	5	1.2	No	Pass	20
	Texture (dry)	5	NS	6.8	8	6	0.8	No	Pass	40
	Flavour (dry)	5	NS	7.0	8	5	1.2	No	Pass	20
	Aroma	5	NS	7.4	8	7	0.5	Yes	Pass	0
	Texture	5	NS	7.4	8	7	0.5	Yes	Pass	0
	Flavour	5	NS	7.4	8	7	0.5	Yes	Pass	0
Cheese, cheddar	Aroma	5	NS	7.4	8	6	0.9	Yes	Pass	20
	Appearance	5	NS	7.6	8	7	0.5	Yes	Pass	0
	Texture	5	NS	7.6	8	7	0.5	Yes	Pass	0
	Flavour	5	NS	7.6	8	7	0.5	Yes	Pass	0
Milk, condensed sweetened	Aroma	5	NS	6.6	8	5	1.3	No	Pass	60
	Appearance	5	NS	7.4	8	7	0.5	Yes	Pass	0
	Texture	5	NS	7.2	8	6	0.8	No	Pass	20
	Flavour	5	NS	7.6	8	7	0.5	Yes	Pass	0
Milk, dried, skim	Aroma (dry)	5	NS	7.0	8	6	0.7	No	Pass	20
	Appearance	5	NS	6.8	8	5	1.1	No	Pass	20
	(ury) Δroma	5	NS	64	Q	5	11	No	Page	60
		5	NS	6.9	Q	5	1.1 1.1	No	Dasa	20
	Tosture	5	NIC	0.0 7 /	0	5	1.1 0 E	INU Voc	Fass Door	20
	Flavour	5 F	NC	7.4 7.0	0 Q	í F	0.0	i es	Fass Dace	20
Pudding Fruit	Aromo	5 F	NC	1.2	0	0	0.0	INU Vee	Fass Doco	20
Fuuuling, Fluit	Aroma	ວ F	NC	1.0	Ó o	(7	0.5 0 =	Tes	Pass	0
	Appearance	5 E	NIC	1.0	0 o	í	0.0	res	Pass	0
	rexture	о г	NC	1.0	ð	0	0.9	res	Pass	20
	riavour	5	UNO	0.1	Ó	(U.D	res	rass	U

¹ NS No Pass/Fail criteria specified in ADFFS (2008). Pass/Fail criteria applied is that stated in Section 2.2.4. ² Pass/Fail specification @ 95% confidence level.

^{3%} Fail based on ADFFS specification.

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Table J1 cont.d Results of sensory compliance testing

Component				9-pa	oint Hedor	nic ratind	results			
p	Attribute	n	ADFFS ¹	Mean	Max	Min	SD	signif. 95%	P/F ²	% Fail ³
Pudding, chocolate	Aroma	5	NS	7.4	8	7	0.5	Yes	Pass	0
	Appearance	5	NS	7.6	8	7	0.5	Yes	Pass	0
	Texture	5	NS	7.6	8	7	0.5	Yes	Pass	0
Dudd'na addau	Flavour	5	NS	7.4	8	7	0.5	Yes	Pass	0
Pudding, golden	Aroma	5	NS NC	7.4	8	5	1.3	No	Pass	20
	Appearance	5	NS NC	7.b 7.0	ð	7	0.5	Yes	Pass	0
	Lexture	5	NO	1.0	0	1	0.4	Yes	Pass	0
Fruit enroad raenhorn	Aromo	5	NS	7.0	9	6	1.1	Ne	Pass	20
r fuit spreau, raspberry	Aronaarance	5	NS	66	0 8	3	1.1 2.1	No	Pass	40 20
	Texture	5	NS	7.6	8	7	0.5	Ves	Dace	20
	Flavour	5	NS	7.6	8	7	0.5	Yes	Pass	0
Vegetable extract	Aroma	5	NS	7.2	8	6	0.8	No	Pass	20
	Appearance	5	NS	7.8	8	7	0.4	Yes	Pass	0
	Texture	5	NS	7.6	8	7	0.5	Yes	Pass	Õ
	Flavour	5	NS	7.8	8	7	0.4	Yes	Pass	0
Chocolate drink powder	Aroma	5	NS	6.4	8	6	0.9	No	Pass	80
	Appearance	5	NS	6.0	7	5	0.7	No	Pass	80
	Texture	5	NS	6.6	8	6	0.9	No	Pass	60
	Flavour	5	NS	7.0	8	6	1.0	No	Pass	40
Coffee, instant	Aroma	5	NS	5.4	8	4	1.7	No	Pass	80
	Appearance	5	NS	6.6	8	5	1.1	No	Pass	40
	Texture	5	NS	5.8	8	4	1.6	No	Pass	60
	Flavour	5	NS	5.6	8	4	1.5	No	Pass	80
Fruit grains, apricot	Aroma	5	NS	7.8	9	7	0.8	Yes	Pass	0
	Appearance	5	NS	7.4	8	7	0.5	Yes	Pass	0
	Texture	5	NS	7.0	8	5	1.2	No	Pass	20
	Flavour	5	NS	7.8	8	7	0.4	Yes	Pass	0
Fruit grains, raspberry	Aroma	5	NS	7.2	8	6	0.8	No	Pass	20
	Appearance	5	NS	6.6	8	4	1.7	No	Pass	40
	Texture	5	NS	7.2	8	6	0.8	No	Pass	20
Fig. 1. sectors and the sector	Flavour	5	NS	7.4	8	1	0.5	Yes	Pass	0
Fruit grains, mixed berry	Aroma	5	NS NC	7.8	8	1	0.4	Yes	Pass	0
	Appearance	5	NG	7.Z	ð	6 7	0.8	NO Voo	Pass	20
	Flovour	5 5	NS	7.0 7.0	0	7	0.4	Yes	Pass	0
Fruit graine, strawborn/	Aromo	5 5	NS	7.0 7.0	0	7	0.4	Yes	Pass	0
i fuit grains, strawberry	Aronaarance	5	NS	7.0 7.2	0 8	6	0.4	No	Pass	20
	Texture	5	NS	7.6	8	7	0.0	Ves	Pass	0
	Flavour	5	NS	7.0	8	7	0.5	Yes	Pass	0
Fruit grains tropical	Aroma	5	NS	7.2	8	7	0.4	Yes	Pass	ů 0
r fait graino, tropical	Appearance	5	NS	7.0	8	6	0.7	No	Pass	20
	Texture	5	NS	7.4	8	7	0.5	Yes	Pass	0
	Flavour	5	NS	7.4	8	7	0.5	Yes	Pass	0
Sauce, BBQ	Aroma	5	NS	6.2	8	4	1.5	No	Pass	60
	Appearance	5	NS	7.0	8	6	0.7	No	Pass	20
	Texture	5	NS	7.2	8	6	0.8	No	Pass	20
	Flavour	5	NS	5.6	8	2	2.3	No	Pass	60
Sauce, sweet chilli	Aroma	5	NS	6.4	8	5	1.1	No	Pass	60
	Appearance	5	NS	6.6	8	5	1.3	No	Pass	60
	Texture	5	NS	7.0	8	6	1.0	No	Pass	40
	Flavour	5	NS	6.4	8	5	1.1	No	Pass	60
Tomato ketchup	Aroma	5	NS	7.6	8	7	0.5	Yes	Pass	0
	Appearance	5	NS	7.2	8	6	0.8	No	Pass	20
	Texture	5	NS	7.4	8	7	0.5	Yes	Pass	0
0 W	Flavour	5	NS	7.6	8	7	0.5	Yes	Pass	0
Sauce, Worcestershire	Aroma	5	NS	7.2	8	7	0.4	Yes	Pass	0
	Appearance	5	NS	7.2	8	7	0.4	Yes	Pass	0
	Texture	5	NS	7.0	8	6	0.7	No	Pass	20
D	Flavour	5	NS	7.6	8	7	0.5	Yes	Pass	0
Pepper, black	Aroma	5	NS	7.8	8	7	0.4	Yes	Pass	0
	Appearanc	5	NS	7.8	8	7	0.4	Yes	Pass	0
	Texture	5	NS	7.6	8	7	0.5	Yes	Pass	0
	Flavour	5	NS	78	8	7	04	Yes	Pass	0

¹ NS No Pass/Fail criteria specified in ADFFS (2008). Pass/Fail criteria applied is that stated in Section 2.2.4. ² Pass/Fail specification @ 95% confidence level.

^{3%} Fail based on ADFFS specification.

Appendix K: Results of Analysis for Warranty Compliance

Table K1 Results of sensory testing following storage at 30 °C for 24 months

Component	9-point Hedonic rating results												
Component	Attribute	n		Moon	Max	Min	200000	signif 05%	D/E2	% Eail3			
Biscuits, cream cracker	Aroma	5	NS	3 /	6	1	2.1	No	Pass	60			
Discuits, cream cracker	Aroma	5	NS	5.4	7	5	2.1 0.8	Voc	Dass	00			
	Appearance	5	NG	0.Z 5.0	7	1	0.0	No	Dass	20			
	Flavour	5	NS	0.0 2.6	7 5	1	2.3	NO	Fass	20			
Risquite plain sweet	Aromo	5	NC	2.0	5	1	1.7	No	Pass	40			
Biscuits, plain, sweet	Aroma	5	NO	4.0	5 7	4	0.5	INO	Fd55	40			
	Appearance	ິ	NO NC	0.2	1	5	0.8	Yes	Pass	0			
	Texture	5	NO NC	0.0	1	5	0.7	res	Pass	0			
Discuite halfes	Flavour	5	NS NC	3.4	4	2	0.9	Yes	Fail	100			
Biscuits, butter	Aroma	5	NS NO	3.8	1	2	1.9	No	Pass	80			
	Appearance	5	NS	6.4	(6	0.5	Yes	Pass	0			
	Texture	5	NS	5.8	6	5	0.4	Yes	Pass	0			
	Flavour	5	NS	2.8	5	1	1.6	Yes	Fail	80			
Biscuits, crispbread	Aroma	5	NS	3.8	6	1	1.9	No	Pass	60			
	Appearance	5	NS	6.0	7	5	1.0	Yes	Pass	0			
	Texture	5	NS	5.6	7	5	0.9	No	Pass	0			
	Flavour	5	NS	4.8	6	4	0.8	No	Pass	40			
Muesli bar, apricot & coconut	Aroma	5	NS	4.6	6	3	1.1	No	Pass	40			
	Appearance	5	NS	4.8	6	3	1.3	No	Pass	40			
	Texture	5	NS	4.0	5	2	1.2	No	Pass	60			
	Flavour	5	NS	3.6	5	1	1.7	No	Pass	60			
Muesli bar, forest fruits	Aroma	5	NS	4.8	6	3	1.3	No	Pass	40			
	Appearance	5	NS	4.8	6	3	1.1	No	Pass	20			
	Texture	5	NS	4.4	6	3	1.3	No	Pass	40			
	Flavour	5	NS	3.4	5	2	1.1	Yes	Fail	80			
Muesli bar. tropical fruit	Aroma	5	NS	5.2	6	3	1.3	No	Pass	20			
	Appearance	5	NS	5.6	6	5	0.5	Yes	Pass	0			
	Texture	5	NS	5.2	7	3	16	No	Pass	40			
	Flavour	5	NS	5.0	7	3	1.6	No	Pass	40			
Muesli mix fruitful	Aroma (drv)	5	NS	5.8	8	5	1.0	No	Pass	40			
	Annoarango	5	110	0.0	0	5	1.5	NO	1 433	0			
	Appearance (dp/)	5	NS	6.2	7	5	0.8	Yes	Pass	0			
	(ury) Texture (dru)	5	NS	E 0	7	4	1 2	No	Deee	20			
	Texture (dry)	5 F	NC	0.0 E.C	7	4	1.3	INO No	Pass	20			
	Flavour (ury)	5 F	NC	5.0 E.C	7	4	1.1	INO No	Pass	20			
	Aroma	5	NO	0.C	1	4	1.1	INO	Pass	20			
	Texture	5	NO	5.2	0	4	1.1	INO	Pass	40			
Man all solar and solar	Flavour	5	NO	5.8	1	5	0.8	Yes	Pass	0			
Muesii mix, naturai	Aroma (dry)	5	NS	5.6	6	5	0.5	Yes	Pass	0			
	Appearance	5	NS	6.0	7	4	1.4	No	Pass	20			
	(dry)	_	10		_				_				
	Texture (dry)	5	NS	5.8	7	4	1.1	No	Pass	20			
	Flavour (dry)	5	NS	5.2	6	5	0.4	No	Pass	0			
	Aroma	5	NS	5.8	7	5	0.8	Yes	Pass	0			
	Texture	5	NS	5.4	6	5	0.5	No	Pass	0			
	Flavour	5	NS	5.4	6	5	0.5	No	Pass	0			
Cheese, cheddar	Aroma	5	NS	5.0	6	3	1.4	No	Pass	40			
	Appearance	5	NS	5.0	6	3	1.4	No	Pass	40			
	Texture	5	NS	5.8	7	4	1.3	No	Pass	20			
	Flavour	5	NS	4.2	6	1	2.0	No	Pass	60			
Milk, condensed sweetened	Aroma	5	NS	5.0	7	3	1.6	No	Pass	40			
	Appearance	5	NS	4.0	6	2	1.6	No	Pass	60			
	Texture	5	NS	3.0	5	1	1.9	Yes	Fail	80			
	Flavour	5	NS	3.8	6	1	1.9	No	Pass	60			
Milk. dried. skim	Aroma (drv)	5	NS	5.6	7	5	0.9	No	Pass	0			
, , -	Appearance	-	NO	0.0	-	0	0.4	N	D	0			
	(drv)	5	NS	0.ð	1	б	0.4	res	Pass	U			
	Aroma	5	NS	5.8	6	5	0.4	Yes	Pass	0			
	Appearance	5	NS	64	7	5	0.9	Yes	Pass	0			
	Texture	5	NS	6.6	7	6	0.5	Yes	Pass	õ			
	Flavour	5	NS	5.6	7	4	11	No	Paee	20			
Pudding Fruit	Aroma	5	NS	6.4	7	F A	0.5	Vec	Pace	0			
r adding, i ruit		5	NS	6.4 6.4	7	6	0.J 0 F	Vec	Pace	0			
	Toyturo	5	NS	0.4 6 0	6	6	0.0	Voc	Dasa	0			
	Flavour	5	NS	6.4	7	6	0.0	Vec	Pace	0			
	1 10/001	5		0.4	1	0	0.0	100	1 4 3 3	0			

¹ NS No Pass/Fail criteria specified in ADFFS (2008). Pass/Fail criteria applied is that stated in Section 2.2.4. ² Pass/Fail specification @ 95% confidence level.

^{3%} Fail based on ADFFS specification.

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Table K1 cont.d Results of sensory testing following storage at 30 °C for 24 months

Component				0_nc	int Hodor	nic rating	roculto			
Component	Attributo	n		Moon	Mov	Min	20113	aignif 05%	D/E2	% Eoil3
Dudding chapalata	Amoute	п г	ADFF31	IVIEdI	IVIAX		30	Sigrifi. 95%	F/F ⁴	% Fall*
Pudding, chocolate	Aroma	5	NS NC	6.0	1	5	1.0	Yes	Pass	0
	Appearance	5	NS NO	6.4	/	6	0.5	Yes	Pass	0
	lexture	5	NS	6.4	1	6	0.5	Yes	Pass	0
	Flavour	5	NS	6.0	7	5	1.0	Yes	Pass	0
Pudding, golden	Aroma	5	NS	7.2	8	6	0.8	Yes	Pass	0
	Appearance	5	NS	6.4	7	5	0.9	Yes	Pass	0
	Texture	5	NS	6.4	7	5	0.9	Yes	Pass	0
	Flavour	5	NS	6.6	7	6	0.5	Yes	Pass	0
Fruit spread, raspberry	Aroma	5	NS	5.8	7	4	1.3	No	Pass	20
	Appearance	5	NS	5.2	7	4	1.6	No	Pass	60
	Texture	5	NS	6.0	7	5	0.7	Yes	Pass	0
	Flavour	5	NS	5.2	8	4	1.8	No	Pass	60
Vegetable extract	Aroma	5	NS	6.2	7	5	0.8	Yes	Pass	0
	Annoaranaa	5	NS	6.4	7	5	0.0	Vee	Dooo	0
	Appearance	5	NG	0.4	7	5	0.9	Yee	Fd55	0
	Texture	5	NO	0.0	7	5	0.9	res	Pass	0
	Flavour	5	INS NC	6.2	/	5	0.8	Yes	Pass	0
Chocolate drink powder	Aroma	5	NS	6.2	[5	0.8	Yes	Pass	0
	Appearance	5	NS	6.4	7	6	0.5	Yes	Pass	0
	Texture	5	NS	6.2	7	5	0.8	Yes	Pass	0
	Flavour	5	NS	6.2	8	5	1.1	Yes	Pass	0
Coffee, instant	Aroma	5	NS	4.6	5	4	0.5	No	Pass	40
	Appearance	5	NS	6.0	7	5	0.7	Yes	Pass	0
	Texture	5	NS	6.2	7	5	0.8	Yes	Pass	0
	Flavour	5	NS	4 0	6	2	16	No	Pass	60
Fruit grains apricot	Aroma	5	NS	4.6	5	4	0.5	No	Pass	40
		5	NS	4.4	6	3	11	No	Pass	60
	Texture	5	NS	5.6	7	1	1.1	No	Dace	20
	Flovour	5	NS	5.0	6	2	1.1	No	Doop	20
Fruit grains, reacherny	Flavour	5	NC	5	0	5	1.2	NO	Fass Dees	20
Fruit grains, raspberry	Aroma	5	NO NC	4.4	0	3	1.1	INO No	Pass	60
	Appearance	5	INS NO	4.6	6	3	1.1	NO	Pass	40
	lexture	5	NS	5.2	1	4	1.3	No	Pass	40
	Flavour	5	NS	4.6	6	3	1.1	No	Pass	40
Fruit grains, mixed berry	Aroma	5	NS	5.2	6	3	1.3	No	Pass	20
	Appearance	5	NS	4.6	6	3	1.1	No	Pass	40
	Texture	5	NS	5.8	7	5	0.8	Yes	Pass	0
	Flavour	5	NS	4.8	6	3	1.3	No	Pass	40
Fruit grains, strawberry	Aroma	5	NS	5.6	8	3	2.1	No	Pass	40
	Appearance	5	NS	4.8	7	3	1.5	No	Pass	40
	Texture	5	NS	5	7	4	12	No	Pass	40
	Flavour	5	NS	5	7	3	14	No	Pass	20
Fruit grains tropical	Aroma	5	NS	52	6	4	0.8	No	Pass	20
r fait graine, tropical	Annearance	5	NS	1.1	6	2	11	No	Dace	60
	Toxturo	5	NS	5.6	7	1	1.1	No	Doop	20
	Flowour	5	NG	5.0	r c	4	1.5	No	Fd55	20
Course BBO	Flavour	5	NO	5.4 C.0	0	5	0.5	INO Mar	Pass	0
Sauce, BBQ	Aroma	5	NO NC	0.0	7	5	0.7	res	Pass	0
	Appearance	5	NS NO	6.0	/	5	1.0	Yes	Pass	0
	lexture	5	NS	6.0	1	4	1.2	No	Pass	20
	Flavour	5	NS	5.6	7	4	1.1	No	Pass	20
Sauce, sweet chilli	Aroma	5	NS	5.4	7	4	1.1	No	Pass	20
	Appearance	5	NS	4.8	6	3	1.1	No	Pass	20
	Texture	5	NS	6.2	7	6	0.4	Yes	Pass	0
	Flavour	5	NS	5.6	6	5	0.5	Yes	Pass	0
Tomato ketchup	Aroma	5	NS	6.0	7	5	0.7	Yes	Pass	0
	Appearance	5	NS	5.8	7	5	0.8	Yes	Pass	0
	Texture	5	NS	6.8	8	6	0.8	Yes	Pass	0
	Flavour	5	NS	6.0	Ř	5	12	No	Pass	ñ
Sauce Worcestershire	Aroma	5	NS	6.0	7	5	10	Vac	Page	0
	Annoaranaa	F	NC	6.0	7	1	1.0	No	Daga	20
	Taxture	5	NC	0.2	7	4	1.3	NU Vee	Pass Dass	20
	Flower	э г	NC	0.0	1	0	0.0	Tes	Pass Date	0
Design block	Flavour	5	NO NO	b.2	ð C	5	1.3	INO	Pass	U
Pepper, black	Aroma	5	NS NS	1.0	8	6	1.0	Yes	Pass	U
	Appearanc	5	NS	6.6	7	6	0.5	Yes	Pass	0
	Texture	5	NS	6.6	7	6	0.5	Yes	Pass	0
	Flavour	5	NS	64	7	6	05	Yes	Pass	0

 Playour
 5
 NS
 6.4
 7
 6
 0.5

 ¹ NS No Pass/Fail criteria specified in ADFFS (2008). Pass/Fail criteria applied is that stated in Section 2.2.4.
 Pass/Fail specification @ 95% confidence level.

 ^{3%} Fail based on ADFFS specification.
 Section 2.2.4.
 Section 2.2.4.

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(a) Initial quality



(d) Quality following 18 months storage at 30 °C

Figure K1 9-pt Hedonic rating: Sensory evaluation of biscuit and muesli bar products

NOTE: For ease of viewing trends with time, error bars have not been included in graphs of Figures K.1 – K.8. Tables J.1 and K.1 of Appendices include data for maximum, minimum and standard deviation of all sensory (acceptability) results.

(b) Quality following 6 months storage at 30 °C



(e) Quality following 24 months storage at 30 $^{\circ}\mathrm{C}$

(c) Quality following 12 months storage at 30 $^{\circ}\mathrm{C}$

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(c) Quality following 12 months storage at 30 °C





(d) Quality following 18 months storage at 30 °C



(e) Quality following 24 months storage at 30 °C

8



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(a) Initial quality



(d) Quality following 18 months storage at 30 °C



(b) Quality following 6 months storage at 30 °C

8

7

6

5

Figure K3 9-*pt Hedonic rating: Sensory evaluation of dairy products*

(c) Quality following 12 months storage at 30 $^{\circ}\mathrm{C}$

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(a) Initial quality



8 7 6 5 4 Score 3 2 1 0 Pudding, Fruit Pudding, Chocolate Pudding, Golden Aroma Appearance Texture Flavour P/F (e) Quality following 24 months storage at 30 °C



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8 7 6 5 Score 3 . 2 1 0 Fruit Grains, Fruit Grains, Fruit Grains, Fruit Grains, Fruit Grains, Mixed Berry Apricot Raspberry Strawberry Tropical Aroma Appearance —____P/F Texture Flavour

2 1 0 Fruit Grains, Fruit Grains, Fruit Grains, Fruit Grains, Fruit Grains Apricot Raspberry Mixed Berry Strawberry Tropical Aroma Appearance Texture Flavour _____P/F

(c) Quality following 12 months storage at 30 °C

8

7

6

aloos

3

(a) Initial quality



(d) Quality following 18 months storage at 30 °C







(e) Quality following 24 months storage at 30 °C

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8 -

7

6

5

3 -

2 · 1 ·

0 -

Aroma

a a a



(c) Quality following 12 months storage at 30 °C



(d) Quality following 18 months storage at 30 °C



Beverage, Chocolate Drink Powder

Appearance



Texture

Beverage, Coffee, Instant

_____P/F

Flavour

DST-Group-TR-3427





(b) Quality following 6 months storage at 30 °C

8

7

6

5

3

2

1 0

Sauce, BBQ



(a) Initial quality







Sauce, Tomato

Sauce.

Sauce, Sweet Chilli



DST-Group-TR-3427







(a) Initial quality



(d) Quality following 18 months storage at 30 °C





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Appendix L: Results of Nutritional Assessment

Component	Protein g/100 g			Fat, total g/100 g		Fat, saturated g/100 g		CHO, total g/100 g		Sugar g/100 g			Energy kJ/100 g			Sodium ma/100 a		a			
	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	9 % agt.3
Biscuits, cream cracker	11.6	12.0	103	17.0	16.6	98	8.4	6.2	74	68.9	62.1	90	<0.5	0.5	-	1995	1900	95	695	750	108
Biscuits, plain, sweet	6.3	5.9	94	16.2	13.6	84	8.3	6.6	80	74.5	71.2	96	27.2	29.3	108	1970	1833	93	310	334	107
Biscuits, butter	6.7	6.6	99	21.9	21.5	98	13.0	12.4	95	68.1	69.1	101	18.1	18.4	102	2080	2047	98	485	505	104
Biscuits, crispbread	11.4	11.2	98	7.5	7.2	96	1.1	1.0	91	77.6	64.0	82	1.0	1.8	180	1785	1630	91	475	490	103
Muesli bar, apricot & coconut	7.9	6.8	86	8.8	8.8	100	2.5	2.4	96	72.1	64.9	90	16.8	15.5	92	1685	1590	94	19.5	9.4	48
Muesli bar, forest fruits	7.5	6.7	89	8.8	8.8	100	2.4	2.4	100	72.7	65.9	91	14.4	16.3	113	1685	1600	95	20.5	9.4	46
Muesli bar, tropical fruit	7.7	6.7	87	8.5	8.8	104	2.3	2.4	104	71.1	65.7	93	17.5	14.4	82	1650	1610	98	25.0	8.4	38
Muesli mix, fruitful	8.7	10.2	117	11.5	9.2	80	1.6	1.9	119	73.1	57.5	79	21.8	16.2	74	1815	1550	85	74.0	571	772
Muesli mix, natural	9.9	9.0	91	7.3	7.0	96	1.5	1.0	67	70.3	62.0	88	23.1	18.0	78	1635	1555	95	41.5	152	366
Cheese, cheddar	18.4	19.0	103	28.9	24.0	83	20.1	17.0	85	3.3	4.9	148	< 0.5	<1	-	1435	1280	89	1400	1470	105
Milk, condensed sweetened	8.5	8.8	104	9.0	8.1	90	6.4	5.5	86	55.4	55.4	100	52.0	55.4	107	1420	1376	97	100	100	100
Milk, dried, skim	28.9	3.3	11	2.0	0.0	NC	1.5	0.0	NC	56.2	3.3	6	55.8	3.3	6	1520	150	10	245	46.7	19
Pudding, fruit	4.4	3.5	80	7.1	8.5	120	3.8	4.1	108	56.0	46.5	83	35.2	28.0	80	1290	1173	91	250	257	103
Pudding, chocolate	3.9	3.3	85	8.6	8.2	95	4.4	3.8	86	52.7	53.0	101	26.9	30.0	112	1275	1263	99	285	255	89
Pudding, golden	3.9	3.3	85	8.2	8.2	100	4.2	3.8	90	53.5	53.0	99	30.4	30.0	99	1275	1263	99	300	255	85
Fruit spread, raspberry	0.4	0.4	100	0.4	0.1	25	-	-	-	63.3	66.9	106	56.5	66.2	117	1100	1131	103	5.3	2.3	43
Vegetable extract	23.0	25.3	110	1.9	<1	NC	0.9	<1	NC	21.2	19.3	91	< 0.5	2.0	>400	819	813	99	2950	3380	115
Chocolate drink powder	5.2	4.0	77	2.9	2.8	97	1.5	1.8	120	89.6	90.9	101	82.4	80.7	98	1720	1670	97	4.5	20.0	444
Coffee, instant	21.9	-	-	0.2	-	-	-	-	-	61.7	-	-	< 0.5	-	-	1430	0	-	-	0.0	-
Fruit grains, apricot	1.0	0.9	90	1.8	1.7	94	-	0.7	-	82.7	70.5	85	57.8	65.5	113	1485	1528	103	30.5	16	52
Fruit grains, raspberry	0.8	0.7	88	1.5	2.0	133	-	0.7	-	85.0	70.0	82	60.8	65.3	107	1515	1540	102	26	14	54
Fruit grains, mixed berry	0.65	0.7	108	0.7	0.33	286	-	0.1	-	84.7	76.0	90	64.6	72.0	111	1475	1513	103	18	12	67
Fruit grains, strawberry	0.8	0.7	88	1.4	2.0	143	-	1.3	-	83.7	70.0	84	58.7	65.3	111	1485	1540	104	15	10	67
Fruit grains, tropical	0.6	0.7	117	0.4	2.0	500	-	0.8	-	84.5	77.1	91	62.5	73.4	117	1460	1568	107	16.5	14	85
Sauce, BBQ	0.85	1.0	118	<0.1	<0.1	NC	-	<0.1	-	30.4	28.0	92	25.0	25.0	100	534	370	69	820	3170	387
Sauce, sweet chilli	0.9	1.0	111	0.3	0.2	67	-	<0.1	-	27.3	25.0	92	21.8	19.0	87	490	370	76	470	420	89
Tomato ketchup	1.1	1.3	118	0.3	3.3	1100	-	0.7	-	24.4	24.0	98	16.2	17.3	107	443	527	119	480	713	149
Sauce, Worcestershire	0.95	1.0	105	0.1	0.1	100	-	-	-	21.7	22.0	101	15.7	15.0	96	389	390	100	1100	1100	100
Pepper, black	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table L1 Manufacturer Nutrient Claims Versus Chemical Analytical Results - Proximates

Pepper, black ¹ Values are those from laboratory analysis

² Values are those from NIP

³ Values in Green/Orange/Red are measure of% agreement between laboratory analysis and NIP values, Orange = disparity ≥20% but <50%, Red = ≥50% disparity

NC = 'not calculated' due to a missing or non-numerical value for "Label Claim". Results are reported for disparity of >50%

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Component	Vitamin B1			Vitamin B ₂			Vitamin B ₃				potassium	1	Calcium			
		mg/100 g			mg/100 g			mg/100 g			mg/100 g			mg/100 g		
	Lab ¹	NIP ²	% agt. ³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt.³	Lab ¹	NIP ²	% agt. ³	
Biscuits, cream cracker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Biscuits, plain, sweet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Biscuits, butter	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Biscuits, crispbread	-	-	-	-	-	-	5.6	5.6	101	-	-	-	-	-	-	
Muesli bar, apricot & coconut	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Muesli bar, forest fruits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Muesli bar, tropical fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Muesli mix, fruitful	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Muesli mix, natural	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cheese, cheddar	-	-	-	-	-	-	-	-	-	-	-	-	585	630	109	
Milk, condensed sweetened	-	-	-	-	-	-	-	-	-	390	377	97	-	-	-	
Milk, dried, skim	-	-	-	-	-	-	-	-	-	-	-	-	845	120	14	
Pudding, fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pudding, chocolate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pudding, golden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fruit spread, raspberry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Vegetable extract	15	11.3	78	14	8.7	62	90	50.0	56	-	-	-	-	-	-	
Chocolate drink powder	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Coffee, instant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fruit grains, apricot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fruit grains, raspberry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fruit grains, mixed berry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fruit grains, strawberry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fruit grains, tropical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sauce, BBQ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sauce, sweet chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tomato ketchup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sauce, Worcestershire	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pepper, black	-	-	-	-	-	-	-	-	-	-		-	-	-	-	

Table L2 Manufacturer Nutrient Claims Versus Chemical Analytical Results - Fortificants

¹ Values are those from laboratory analysis ² Values are those from NIP

³ Values in Green/Orange/Red are measure of% agreement between laboratory analysis and NIP values, Orange = disparity ≥20% but <50%, Red = ≥50% disparity
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	Sampling	Protein	Fat, total	Moisture	Ash	Fat,	Fat, mono-	Fat, poly	Fat, trans-	CHO, total	Sugar,	Energy
Component	point ²					saturated	unsaturated	unsaturated			total	
		(g/100 g)										(kJ/100 g)
Biscuits, cream cracker	initial	11.6	17.0	0.6	2.1	8.4	6.4	2.1	< 0.1	68.9	< 0.5	1995
Biscuits, cream cracker	final	11.5	16.6	3.7	2.2	8.5	6.5	1.6	0.1	66.1	10.8	1935
Biscuits, plain sweet	initial	6.3	16.2	2.1	1.0	8.3	6.1	1.9	< 0.1	74.5	27.2	1970
Biscuits, plain sweet	final	6.7	15.9	3.6	1.1	8.2	6.1	1.6	0.1	72.9	29.0	1935
Biscuits, butter	initial	6.7	22.4	2.0	1.5	13.0	7.2	1.7	0.1	68.1	18.1	2080
Biscuits, butter	final	6.3	21.7	3.1	1.5	12.7	7.3	1.6	0.2	67.7	18.6	2060
Biscuits, crispbread	initial	11.4	7.5	1.1	2.5	1.1	4.4	2.1	< 0.1	77.6	1.0	1785
Biscuits, crispbread	final	11.8	7.1	3.6	2.6	1.2	4.5	1.5	0.1	75.0	1.3	1735
Muesli bar, apricot & cocnut	initial	7.9	8.8	10.3	1.1	2.5	3.8	2.5	< 0.1	72.1	16.8	1685
Muesli bar, apricot & cocnut	final	8.8	9.2	8.3	1.1	2.6	4.1	2.6	0.1	72.7	15.9	1730
Muesli bar, forest fruits	initial	7.5	8.8	10.2	1.0	2.4	3.9	2.5	< 0.1	72.7	14.4	1685
Muesli bar, forest fruits	final	8.4	8.8	8.0	1.0	2.5	3.9	2.5	0.1	73.9	15.8	1720
Muesli bar, tropical fruit	initial	7.7	8.5	12.1	0.8	2.3	3.7	2.5	< 0.1	71.1	17.5	1650
Muesli bar, tropical fruit	final	8.0	9.3	8.2	1.0	2.6	4.1	2.6	0.1	73.6	17.2	1730
Muesli mix, fruitful	initial	8.7	11.5	5.4	1.4	1.6	6.3	3.7	< 0.1	73.1	21.8	1815
Muesli mix, fruitful	final	9.4	12.2	4.1	1.3	1.6	6.7	3.9	0.1	73.0	21.9	1850
Muesli mix, natural	initial	9.9	7.3	10.8	1.8	1.5	3.2	2.7	< 0.1	70.3	23.1	1635
Muesli mix, natural	final	10.1	7.0	7.7	1.7	1.4	3.1	2.5	< 0.1	73.7	23.0	1675
Cheese, cheddar	initial	18.4	28.9	44.4	5.2	20.1	7.7	0.8	0.3	3.3	< 0.5	1435
Cheese, cheddar	final	19.8	28.5	44.3	5.2	19.4	7.8	0.9	0.4	2.3	0.3	1430
Milk, condensed, sweetened	initial	8.5	9.0	25.4	1.8	6.4	2.3	0.3	< 0.1	55.4	52.0	1420
Milk, condensed, sweetened	final	8.8	8.1	27.4	2.0	5.9	2.0	0.2	0.1	53.7	52.7	1365
Milk, dried, skim	initial	28.9	2.0	5.1	7.9	1.5	< 0.5	< 0.1	< 0.1	56.2	55.8	1520
Milk, dried, skim	final	31.5	1.2	4.9	7.9	0.7	0.4	0.1	0.1	54.6	52.8	1510
Pudding, fruit	initial	4.4	7.1	31.3	1.2	3.8	2.7	0.7	< 0.1	56.0	35.2	1290
Pudding, fruit	final	4.9	8.2	32.6	1.2	4.2	3.1	0.9	0.1	53.3	34.2	1290
Pudding, chocolate	initial	3.9	8.6	34.0	1.0	4.4	3.3	0.9	< 0.1	52.7	26.9	1275
Pudding, chocolate	final	4.0	8.1	33.0	1.1	4.0	3.2	0.9	0.0	53.8	21.9	1285
Pudding, golden	initial	3.9	8.2	33.6	0.9	4.2	3.2	0.8	< 0.1	53.5	30.4	1275
Pudding, golden	final	4.0	7.9	34.0	1.1	3.8	3.2	0.8	0.1	53.1	27.0	1260

*Table L3 Initial proximate content and retention levels at end of warranty*¹

¹ Mean values reported, n=2. ² Initial – Samples tested at Receival; Final-Samples tested following storage at 30 °C for 24 months.

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Table L3 cont'd *Initial proximate content ad retention levels at end of warranty*¹

Component	Sampling	Protein	Fat, total	Moisture	Ash	Fat, saturated	Fat, mono-	Fat, poly	Fat, trans-	CHO, total	Sugar, total	Energy
	noinf		(g/100 g)									
Frui spread, raspberry	initial	0.4	0.4	35.7	0.2	-	-	-	-	63.3	56.5	1100
Frui spread, raspberry	final	0.5	0.3	37.0	0.2	-	-	-	-	62.2	60.9	1075
Vegetable extract	initial	23.0	1.9	40.1	13.9	0.9	0.8	0.2	< 0.1	21.2	< 0.5	819
Vegetable extract	final	23.9	1.3	40.5	14.1	0.7	0.5	0.1	0.1	20.3	9.1	800
Chocolate drink powder	initial	5.2	2.9	0.7	1.7	1.5	0.9	0.6	< 0.1	89.6	82.4	1720
Chocolate drink powder	final	5.2	3.5	0.4	1.5	1.7	1.0	0.8	0.1	89.5	80.5	1735
Coffee, instant	initial	21.9	0.1	8.5	7.9	-	-	-	-	61.7	< 0.5	1430
Coffee, instant	final	23.8	0.5	5.0	7.6	-	-	-	-	63.3	< 0.5	1495
Fruit grains, apricot	initial	1.0	1.8	13.4	1.3	-	-	-	-	82.7	57.8	1485
Fruit grains, apricot	final	1.1	2.4	17.4	1.3	-	-	-	-	78.0	59.6	1430
Fruit grains, raspberry	initial	0.8	1.5	11.9	0.9	-	-	-	-	85.0	60.8	1515
Fruit grains, raspberry	final	1.2	1.9	11.7	0.8	-	-	-	-	84.5	61.5	1525
Fruit grains, mixed berry	initial	0.7	0.7	12.6	1.3	-	-	-	-	84.7	64.6	1475
Fruit grains, mixed berry	final	1.2	0.8	11.7	1.1	-	-	-	-	85.3	65.3	1500
Fruit grains, straw berry	initial	0.8	1.4	13.5	0.8	-	-	-	-	83.7	58.7	1485
Fruit grains, straw berry	final	1.4	1.9	12.2	0.7	-	-	-	-	83.9	61.1	1520
Fruit grains, tropical	initial	0.6	0.4	13.0	1.6	-	-	-	-	84.5	62.5	1460
Fruit grains, tropical	final	1.1	1.4	9.6	1.1	-	-	-	-	86.8	61.6	1545
Sauce, BBQ	initial	0.9	< 0.1	65.6	3.2	-	-	-	-	30.4	25.0	534
Sauce, BBQ	final	2.0	0.3	63.4	2.0	-	-	-	-	32.4	23.3	593
Sauce, sweet chilli	initial	0.9	0.3	69.8	1.8	-	-	-	-	27.3	21.8	490
Sauce, sweet chilli	final	1.4	0.2	46.0	4.3	-	-	-	-	48.1	36.2	848
Tomato ketchup	initial	1.1	0.3	72.4	1.8	-	-	-	-	24.4	16.2	444
Tomato ketchup	final	1.5	0.4	67.9	2.0	-	-	-	-	28.3	19.6	522
Sauce, worcestershire	initial	1.0	0.1	72.8	4.4	-	-	-	-	21.7	15.7	389
Sauce, worcestershire	final	1.4	0.2	66.4	5.3	-	-	-	-	26.9	19.2	486
Pepper, black	initial	-	-	-	-	-	-	-	-	-	-	-
Pepper, black	final	-	-	-	-	-	-	-	-	-	-	-

¹Mean values reported, n=2.
² Initial – Samples tested at Receival; Final-Samples tested following storage at 30 °C for 24 months.

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*Table L4 Initial vitamin content and retention levels at end of warranty*¹

	Sampling										
Component	point ²	Vitamin A	Vitamin B ₁	Vitamin B ₂	Vitamin B ₃	Vitamin B ₆	Vitamin B ₁₂	Vitamin C	Vitamin E	Vitamin K ₁	Folate
		(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)
Biscuits, cream cracker	initial	< 3	0.17	0.06	1.1	0.04	< 0.03	5	3.2	1.0	71
Biscuits, cream cracker	final	< 1	0.17	0.08	1.6	0.01	< 0.05	5	0.5	1.4	24
Biscuits, plain sweet	initial	< 3	0.12	0.01	< 1	<0.02	< 0.03	4	3.5	1.0	46
Biscuits, plain sweet	final	< 1	0.11	0.01	< 1	0.01	< 0.05	13	0.5	1.1	2
Biscuits, butter	initial	110	0.12	0.05	< 1	0.02	< 0.03	4	3.5	1.0	45
Biscuits, butter	final	110	0.10	0.03	< 1	0.01	< 0.05	< 1	0.5	1.6	2
Biscuits, crispbread	initial	< 3	0.09	0.04	5.6	0.04	< 0.03	5	2.8	3.0	58
Biscuits, crispbread	final	< 1	0.11	0.04	5.8	0.01	< 0.05	25	0.9	2.3	32
Muesli bar, apricot & cocnut	initial	< 3	0.14	0.02	< 1	<0.02	< 0.03	< 1	1.2	4.0	66
Muesli bar, apricot & cocnut	final	< 1	0.11	0.01	1.1	0.01	< 0.05	< 1	0.8	3.1	2
Muesli bar, forest fruits	initial	< 3	0.16	0.01	< 1	<0.02	< 0.03	< 1	1.2	4.5	46
Muesli bar, forest fruits	final	< 1	0.14	0.01	< 1	0.01	< 0.05	< 1	0.7	3.3	14
Muesli bar, tropical fruit	initial	< 3	0.14	0.01	< 1	<0.02	< 0.03	< 1	1.0	3.5	38
Muesli bar, tropical fruit	final	< 1	0.11	0.01	< 1	0.01	< 0.05	< 1	0.5	2.9	2
Muesli mix, fruitful	initial	< 5	0.24	0.02	< 1	<0.02	< 0.03	3.8	1.5	9.0	39
Muesli mix, fruitful	final	< 5	0.22	0.01	< 1	0.02	< 0.05	< 1	0.8	8.1	21
Muesli mix, natural	initial	< 5	0.26	0.09	1.1	<0.02	< 0.03	< 1	1.0	< 1	50
Muesli mix, natural	final	< 5	0.19	0.12	1.5	0.03	< 0.05	< 1	0.1	1.2	33
Cheese, cheddar	initial	295	<0.02	0.26	< 1	<0.02	1.9	< 1	1.2	2.0	-
Cheese, cheddar	final	955	0.02	0.29	< 1	0.01	1.6	< 1	1.2	2.7	-
Milk, condensed, sweetened	initial	19	0.05	0.45	< 1	<0.02	0.45	1.4	< 0.01	< 1	-
Milk, condensed, sweetened	final	68	0.01	0.29	< 1	0.01	0.10	< 1	0.1	< 1	-
Milk, dried, skim	initial	< 30	0.26	2.20	< 1	0.24	0.83	9	< 0.5	< 1	-
Milk, dried, skim	final	-	-	-	< 1	0.19	1.2	-	-	< 1	-
Pudding, fruit	initial	< 3	0.09	0.11	< 1	<0.02	0.07	< 1	1.8	3.0	-
Pudding, fruit	final	< 1	0.10	0.07	< 1	0.01	< 0.05	< 1	1.8	4.4	-
Pudding, chocolate	initial	13	<0.02	0.09	< 1	<0.02	0.19	< 1	2.1	< 1	-
Pudding, chocolate	final	30	0.02	0.08	< 1	0.01	< 0.05	< 1	1.8	< 1	-
Pudding, golden	initial	14	0.04	0.08	< 1	<0.02	0.16	< 1	2.0	< 1	-
Pudding, golden	final	35	0.02	0.07	< 1	0.01	< 0.05	< 1	1.8	< 1	-

¹Mean values reported, n=2. ² Initial – Samples tested at Receival; Final-Samples tested following storage at 30 °C for 24 months.

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Table L4 cont'd *Initial vitamin content and retention levels at end of warranty*¹

Component	Sampling	Vitamin A	Vitamin B ₁	Vitamin B ₂	Vitamin B ₃	Vitamin B ₆	Vitamin B ₁₂	Vitamin C	Vitamin E	Vitamin K ₁	Folate
	point ²	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)
Frui spread, raspberry	initial	< 3	< 0.02	< 0.01	< 1	< 0.02	< 0.03	< 1	.0.15	1	-
Frui spread, raspberry	final	< 1	0.01	< 0.01	< 1	0.01	< 0.05	< 1	0.15	1.1	-
Vegetable extract	initial	< 3	15	14	90	0.13	< 0.03	24	< 1	< 1	-
Vegetable extract	final	< 1	0.72	12	85	0.01	0.39	28	0.05	< 1	-
Chocolate drink pow der	initial	< 3	< 0.02	0.06	< 1	0.03	< 0.03	9	< 0.5	1	-
Chocolate drink pow der	final	< 1	0.07	0.06	< 1	0.01	< 0.05	12	0.11	2.1	-
Coffee, instant	initial	-	-	-	-	-	-	-	-	-	-
Coffee, instant	final	-	-	-	-	-	-	-	-	-	-
Fruit grains, apricot	initial	< 3	< 0.02	0.01	< 1	0.02	< 0.03	88	2.8	8	32
Fruit grains, apricot	final	20	0.02	0.02	< 1	0.01	< 0.05	5	1.3	9.7	15
Fruit grains, raspberry	initial	< 3	< 0.02	0.01	< 1	0.03	< 0.03	30	0.6	3.5	7
Fruit grains, raspberry	final	< 1	0.02	0.03	< 1	0.01	< 0.05	47	0.25	4.9	30
Fruit grains, mix ed berry	initial	< 3	< 0.02	0.01	< 1	0.04	< 0.03	57	0.9	2	< 3
Fruit grains, mix ed berry	final	< 1	0.02	0.01	< 1	0.01	< 0.05	42	0.4	1.5	48
Fruit grains, straw berry	initial	< 3	< 0.02	0.02	< 1	0.03	< 0.03	59	0.8	3	< 3
Fruit grains, straw berry	final	< 1	0.03	0.02	< 1	0.02	< 0.05	16	0.6	5.3	93
Fruit grains, tropical	initial	< 3	< 0.02	0.01	< 1	0.04	< 0.03	80	0.4	2	< 3
Fruit grains, tropical	final	< 1	0.02	0.01	< 1	0.01	< 0.05	< 1	0.4	1.9	29
Sauce, BBQ	initial	-	-	-	-	-	-	-	-	-	-
Sauce, BBQ	final	-	-	-	-	-	-	-	-	-	-
Sauce, sweet chilli	initial	-	-	-	-	-	-	-	-	-	-
Sauce, sweet chilli	final	-	-	-	-	-	-	-	-	-	-
Tomato ketchup	initial	-	-	-	-	-	-	-	-	-	-
Tomato ketchup	final	-	-	-	-	-	-	-	-	-	-
Sauce, worcestershire	initial	-	-	-	-	-	-	-	-	-	-
Sauce, worcestershire	final	-	-	-	-	-	-	-	-	-	-
Pepper, black	initial	-	-	-	-	-	-	-	-	-	-
Pepper, black	final	-	-	-	-	-	-	-	-	-	-

¹ Mean values reported, n=2. ² Initial – Samples tested at Receival; Final-Samples tested following storage at 30 °C for 24 months.

	Sampling												
Component	point ²	lodine	Manganese	Phosphorous	Sodium	Potassium	Copper	Magnesium	Zinc	Calcium	Iron	Selenium	Chromium
		mg/kg											
Biscuits, cream cracker	initial	0.265	11	1100	6950	1500	1.4	295	6.7	210	10	0.092	< 0.01
Biscuits, cream cracker	final	0.265	9.35	1050	6800	1450	1.25	290	8.4	195	9.5	0.092	0.012
Biscuits, plain sweet	initial	0.435	7.65	680	3100	1000	1.05	205	3.85	125	7.1	0.05	< 0.01
Biscuits, plain sweet	final	0.29	6.2	675	3000	975	0.93	200	5.2	120	6.8	0.053	0.01
Biscuits, butter	initial	0.101	7.4	765	4850	1150	0.99	205	4.05	190	7.3	0.05	< 0.01
Biscuits, butter	final	0.32	6.3	785	4850	1150	1.145	210	5.6	190	7.4	0.05	< 0.01
Biscuits, crispbread	initial	< 0.01	41	3300	4750	4050	4.6	1300	17.5	370	28.5	0.033	< 0.01
Biscuits, crispbread	final	0.03	37	3400	4950	4100	4.1	1350	22	380	30.5	0.032	< 0.01
Muesli bar, apricot & cocnut	initial	0.013	25	2050	195	2800	2.9	690	13	280	22	0.092	< 0.01
Muesli bar, apricot & cocnut	final	0.015	24	2250	210	2800	2.3	770	16	265	23	0.083	< 0.01
Muesli bar, forest fruits	initial	< 0.01	25	2100	205	2450	2.5	720	12	245	22	0.093	< 0.01
Muesli bar, forest fruits	final	0.013	23	2100	220	2550	2.1	735	14	250	22	0.073	< 0.01
Muesli bar, tropical fruit	initial	< 0.01	27	2150	250	2150	2.3	700	12	260	23	0.066	< 0.01
Muesli bar, tropical fruit	final	< 0.01	25	2150	325	2200	2	705	15	260	22	0.049	< 0.01
Muesli mix, fruitful	initial	< 0.01	37	2550	740	2850	2.25	905	13	460	29.5	0.028	< 0.01
Muesli mix, fruitful	final	0.05	36	2750	720	2900	1.9	970	19	465	31	0.022	< 0.01
Muesli mix, natural	initial	0.022	36.5	3050	415	3900	2.75	1100	15.5	550	38.5	0.093	0.13
Muesli mix, natural	final	0.045	41	3500	290	4550	2.5	1250	24	560	40	0.09	0.021
Cheese, cheddar	initial	0.28	0.29	4150	14000	695	0.25	235	24	5850	3.95	0.095	0.034
Cheese, cheddar	final	0.28	0.29	3950	14000	610	0.26	225	29	5800	39	0.093	0.052
Milk, condensed, sweetened	initial	0.855	0.11	2600	1000	3900	0.12	295	10	3250	< 2	0.058	< 0.01
Milk, condensed, sweetened	final	0.49	0.074	2700	945	4150	0.14	290	12	3400	< 2	0.052	< 0.01
Milk, dried, skim	initial	0.45	0.24	6900	2450	12000	0.33	760	19.5	8450	< 2	0.082	0.022
Milk, dried, skim	final	0.38	0.26	10500	3600	18000	0.39	1050	35	12000	< 2	0.16	< 0.01
Pudding, fruit	initial	0.14	3.9	720	2500	2650	1.35	200	2.65	380	8.25	0.033	< 0.01
Pudding, fruit	final	0.091	3.6	740	2500	2650	1.2	205	3.3	400	12	0.032	< 0.01
Pudding, chocolate	initial	0.11	4	1500	2850	1400	1.4	230	3.45	460	14.5	0.043	0.15
Pudding, chocolate	final	0.1	3.8	1500	2700	1350	1.3	250	4.6	480	15	0.054	0.099
Pudding, golden	initial	0.091	2.9	1400	3000	835	0.49	110	2.35	510	5.85	0.049	< 0.01
Pudding, golden	final	0.094	2.8	1350	3050	835	0.43	120	3	530	5.8	0.048	< 0.01

Initial mineral and trace element content and retention levels at end of warranty Table L5

¹Mean values reported, n=2. ²Initial – Samples tested at Receival; Final-Samples tested following storage at 30 °C for 24 months.

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	Sampling												
Component	point ²	lodine	Manganese	Phosphorous	Sodium	Potassium	Copper	Magnesium	Zinc	Calcium	Iron	Selenium	Chromium
		mg/kg											
Frui spread, raspberry	initial	< 0.01	0.5	53	53	755	0.16	47	0.56	49	<2	< 0.01	< 0.01
Frui spread, raspberry	final	< 0.01	0.625	70	56	700	0.235	56	0.895	69	<2	< 0.01	< 0.01
Vegetable extract	initial	0.057	4.55	7550	29500	23000	2.35	1200	46.5	900	42	0.19	0.06
Vegetable extract	final	0.0425	4.15	7400	34000	22500	2.2	1200	55.5	895	41.5	0.26	0.0535
Chocolate drink powder	initial	< 0.01	12	1950	44.5	4700	6.3	1300	11	455	76	< 0.01	0.26
Chocolate drink powder	final	< 0.01	13	1850	15	4800	6.45	1200	16.5	450	67	0.024	0.16
Coffee, instant	initial	-	-	-	-	-	-	-	-	-	-	-	-
Coffee, instant	final	-	-	-	-	-	-	-	-	-	-	-	-
Fruit grains, apricot	initial	< 0.01	0.64	330	305	5100	1.1	175	1.25	255	6.8	< 0.01	0.03
Fruit grains, apricot	final	0.019	0.69	330	300	5450	1.2	175	1.5	255	7.3	< 0.01	0.161
Fruit grains, raspberry	initial	< 0.01	3.3	315	260	3100	0.86	180	1.15	225	6.95	< 0.01	0.06
Fruit grains, raspberry	final	< 0.01	3.3	315	260	3100	0.86	180	1.15	225	6.95	< 0.01	0.0635
Fruit grains, mixed berry	initial	< 0.01	1.35	290	180	4350	0.79	165	0.65	190	5.9	< 0.01	0.06
Fruit grains, mixed berry	final	< 0.01	1.35	290	180	4350	0.79	165	0.645	190	5.9	< 0.01	0.0635
Fruit grains, straw berry	initial	< 0.01	2.2	300	150	2750	0.88	160	1.05	220	7	< 0.01	0.18
Fruit grains, straw berry	final	< 0.01	2.2	300	150	2750	0.875	160	1.05	220	7	< 0.01	0.18
Fruit grains, tropical	initial	< 0.01	4.9	250	165	4450	0.85	175	0.83	185	7.95	< 0.01	0.07
Fruit grains, tropical	final	< 0.01	4.9	250	165	4450	0.845	175	0.83	185	7.95	< 0.01	0.0715
Sauce, BBQ	initial	0.135	5.65	150	8200	3650	0.81	280	1.04	740	16.5	< 0.01	0.13
Sauce, BBQ	final	< 0.01	0.955	250	4700	2900	0.515	115	0.93	215	4.75	< 0.01	0.044
Sauce, sweet chilli	initial	< 0.01	0.96	250	4700	2900	0.52	115	0.93	215	4.75	< 0.01	0.04
Sauce, sweet chilli	final	0.135	5.65	150	8200	3650	0.81	280	1.035	740	16.5	< 0.01	0.13
Tomato ketchup	initial	< 0.01	1.3	215	4800	3050	0.87	130	1.1	215	5.05	< 0.01	0.1
Tomato ketchup	final	0.025	1.4	2.5	5600	5350	1.1	140	1.6	240	4.4	0.016	0.13
Sauce, worcestershire	initial	0.17	5.6	230	11000	4950	2.25	450	1.65	2100	38.5	< 0.01	0.19
Sauce, worcestershire	final	0.2	6.7	300	1350	5900	3.4	530	2.8	2350	4.4	0.068	0.22
Pepper, black	initial	-	-	-	-	-	-	-	-	-	-	-	-
Pepper, black	final	-	-	-	-	-	-	-	-	-	-	-	-

Table L5 cont'd Initial mineral and trace element content and retention levels at end of warranty

Mean values reported, n=2.

² Initial – Samples tested at Receival; Final-Samples tested following storage at 30 °C for 24 months.

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19. ABSTRACT								
Quality assurance (QA) testing of current combat ration pack (CRP) components was carried out in support of through-life management of CRP. The QA program involved inspection and testing, interpretation of results for compliance assessment and reporting. Many products were found to be non-compliant with ADF Food Specifications and/or national food standards current at the								

time of testing. The single most common issue was failure to meet fortification requirements. Recommendations to improve the safety and quality of CRP are provided: maintain relevant functional and performance requirements in ADF Food Specifications; ensure compliance with the requirements; and maintain a continuous improvement process for CRP components, packaging and documentation. Ongoing collaborative effort among CRP suppliers, Capability Acquisition and Sustainment Group and DST Group has seen the majority, if not all, the recommendations in this report implemented.