

Food and Agriculture Organization of the United Nations



Microbial safety of lipid-based ready-to-use foods for management of moderate acute malnutrition and severe acute malnutrition

SECOND REPORT





MICROBIOLOGICAL RISK ASSESSMENT SERIES



# Microbial safety of lipid-based ready-to-use foods for management of moderate acute malnutrition and severe acute malnutrition

SECOND REPORT

Food and Agriculture Organization of the United Nations World Health Organization

Rome, 2021

#### Required citation:

FAO and WHO. 2021. *Microbial safety of lipid-based ready-to-use foods for management of moderate acute malnutrition and severe acute malnutrition* – Second report. Microbiological Risk Assessment Series No. 29. Rome. https://doi.org/10.4060/cb3223en

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) or the World Health Organization (WHO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO or WHO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO or WHO.

ISSN 1726-5274 [Print] ISSN 1728-0605 [Online] FAO ISBN 978-92-5-133930-5 WHO ISBN 978-92-4-001991-1 (print version) WHO ISBN 978-92-4-001990-4 (electronic version) © FAO and WHO, 2021



Some rights reserved. This work is made available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; https://creativecommons.org/licenses/by-nc-sa/3.0/igo/legalcode).

Under the terms of this licence, this work may be copied, redistributed and adapted for non-commercial purposes, provided that the work is appropriately cited. In any use of this work, there should be no suggestion that FAO or WHO endorses any specific organization, products or services. The use of the FAO or WHO logo is not permitted. If the work is adapted, then it must be licensed under the same or equivalent Creative Commons licence. If a translation of this work is created, it must include the following disclaimer along with the required citation: "This translation was not created by the Food and Agriculture Organization of the United Nations (FAO) or the World Health Organization (WHO). Neither FAO nor WHO is responsible for the content or accuracy of this translation. The original English edition shall be the authoritative edition."

Disputes arising under the licence that cannot be settled amicably will be resolved by mediation and arbitration as described in Article 8 of the licence except as otherwise provided herein. The applicable mediation rules will be the mediation rules of the World Intellectual Property Organization http:// www.wipo.int/amc/en/mediation/rules and any arbitration will be conducted in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL).

**Third-party materials**. Users wishing to reuse material from this work that is attributed to a third party, such as tables, figures or images, are responsible for determining whether permission is needed for that reuse and for obtaining permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

**Sales, rights and licensing.** FAO information products are available on the FAO website (www.fao.org/ publications) and can be purchased through publications-sales@fao.org. Requests for commercial use should be submitted via: www.fao.org/contact-us/licence-request. Queries regarding rights and licensing should be submitted to: copyright@fao.org.

Cover picture © Dennis Kunkel Microscopy, Inc

# Contents

Preface	vii
Acknowledgements	viii
Contributors	ix
Declarations of interest	xi
Abbreviations and acronyms	xii
Executive summary	xiii
Background	1
2 Introduction	4
2.1 Definitions of acute malnutrition	4
2.2 Management of MAM and SAM	5
2.3 Ready-to-use foods for acute malnutrition	6
2.3.1 Lipid-based RUF ingredients	7
2.3.2 Manufacture of RUFs for acute malnutrition	7
2.4 Relationship between malnutrition and infection	8
Risk assessment for lipid-based RUFs used to manage	9
MAM and SAM	11
3.1 Hazard identification	11
3.2 Hazard characterization	17
3.3 Exposure assessment	25
3.4 Risk characterization	27
4 Managing the risk of salmonellosis from lipid-based R	RUFs
fed to children 6–59 months of age with MAM and SA	M 31
4.1 Risk-based food safety management	31
4.1.1 Good hygienic practices	31
4.1.2 Raw ingredients	32
4.1.3 Intervention technologies	32
4.1.4 Re-contamination	32
4.2 The role of microbiological testing in food safety managen	nent 33
4.2.1 Setting a microbiological criterion	38
4.2.2 Example approaches to setting a microbiological criterio for ready-to-use foods	n 39

5	Conclusions	45
	5.1 Pathogen(s) of concern	45
	5.2 Susceptibility of children with SAM relative to children of the same age without malnutrition	45
	5.3 Assessing the probability of foodborne infection from RUFs	46
	5.4 Potential to implement kill steps to further reduce microbial contamination	47
	5.5 Microbiological criteria appropriate to lipid-based RUFs and how they should be used	48
6	Recommendations	49
	6.1 Recommendations for manufacturers	49
	6.2 Recommendations for agencies	51
	References	53

#### ANNEXES

Annex 1	Overview of ready-to-use foods for acute malnutrition	68
Annex 2	Analysis of published models for dose-response of Salmonella and additional relevant data, including derivation of exponential dose-response models from Salmonella outbreaks associated with low-moisture foods	74
Annex 3	Re-analysis of Teunis <i>et al.</i> (2010) dataset as a beta-Poisson model and comparison with the FAO/WHO (2002) <i>Salmonella</i> dose-response model	77

#### TABLES

Table 1	Pathogens identified as causes of serious infections in South African children with severe acute malnutrition	12
Table 2	Pathogenic micro-organisms considered in the hazard identification	15
Table 3	Examples of the predicted risk of gastrointestinal salmonellosis for SAM children receiving a full course of RUFs (62 servings) based on different levels and frequencies of RUF contamination	28
Table 4:	Relationship between the number of 100 g servings analysed and the probability of accepting a contaminated lot	29

#### FIGURES

Figure 1.	Community management of acute malnutrition (CMAM) is the most widely accepted model for managing malnutrition, and uses triage for management options for acute malnutrition	5
Figure 2.	Generalized production flow diagram for lipid-based RUFs	8
Figure 3	Examples of relationships between dose and probability of gastrointestinal non-typhoidal Salmonella infection	19
Figure 4	Examples of the predicted relationships between dose and probability of gastrointestinal non-typhoidal Salmonella infection from different models	20
Figure 5	Examples of the predicted relationships between dose and probability of gastrointestinal non-typhoidal Salmonella infection from different models with both modelled responses shown on a linear scale	21
Figure 6	FAO and WHO (2002) "dose-vs-probability of gastrointestinal non-typhoidal salmonellosis" model	22
Figure 7	FAO/WHO (2002) "dose-vs-probability of gastrointestinal non-typhoidal salmonellosis" model compared with a beta-Poisson model fitted to the expanded salmonellosis database (after correction for transcription errors) presented in Teunis <i>et al.</i> (2010)	24
Figure 8	The relative sensitivity of different sampling plans to detect contamination of RUF meals by different levels of <i>Salmonella</i> and their relationship to realistic contamination levels.	35

### Preface

This was the second meeting to address the issue of microbial safety of lipid-based ready-to-use foods for management of moderate and severe acute malnutrition. The deliberations of this meeting served to build on the findings of the first meeting, and to revise and update the recommendations of that meeting according to new information generated in the meantime. The first meeting was implemented in a crisis situation where there was an urgent need to address the microbiological safety of these products, and the recommendations from that meeting reflect that situation and were, as a result, more reactive in nature. This second meeting was able to take a more holistic view of the microbiological safety of these products and look towards a more long-term approach to managing the safety of these products in a proactive and sustainable manner.

# 预览已结束, 完整报告链接和

https://www.yunbaogao.cn/report/index/repo