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Improving Young Child Feeding in Eastern and Southern Africa

Household-Level Food Technology

Proceedings of a workshop
held in Nairobi, Kenya,
12-16 October 1987

Proceedings

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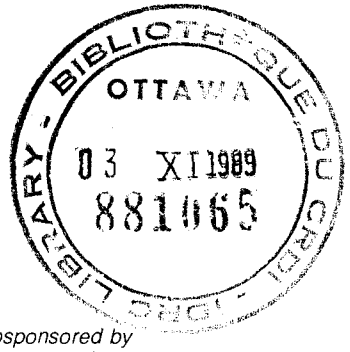
Editors: D. Alnwick, S. Moses,
and O.G. Schmidt



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Abstract

The weaning period, that is the period in a young child's life when supplementary foods are introduced to complement breast milk, poses great nutritional risk to children in developing countries. By the end of the second year of life, one-third of children in eastern and southern Africa are chronically malnourished. The following factors contribute to the growth faltering commonly observed in weaning-age children: low nutrient intake, high incidence of diarrheal disease (often caused by contaminated weaning foods), and recent declines in duration and intensity of breastfeeding.

Food scientists, nutritionists, and health planners working in Africa and South Asia met in an international workshop to examine household-level food technologies that hold promise for improving nutrition of infants and young children. After reviewing current knowledge of breastfeeding and weaning practices in eastern and southern Africa, participants discussed the use in weaning diets of fermented foods and germinated flour, for both improved nutrient intake by young children and decreased risk of food contamination. Research that should be conducted into the effectiveness of the food technology was identified and its diffusion at the community level discussed.

This publication contains the proceedings, conclusions, and recommendations of the workshop. It is directed at scientists and health planners who are involved in nutrition research and developing programs to improve feeding of infants and young children in developing countries.

Résumé

Le sevrage, c'est-à-dire la période où l'on commence à donner des aliments solides à un jeune enfant en complément du lait maternel, présente de graves risques nutritionnels pour les enfants dans les pays en développement. Dès la fin de leur deuxième année, le tiers des enfants en Afrique orientale et australe souffrent de malnutrition chronique. Les facteurs suivants sont à l'origine du retard de croissance que l'on retrouve couramment chez les enfants en âge d'être sevrés : carence nutritionnelle, forte prévalence des maladies diarrhéiques (qui s'expliquent souvent par la contamination des aliments) et diminution récente de la durée et de l'intensité de l'allaitement maternel.

Des spécialistes des sciences de l'alimentation, des nutritionnistes et des planificateurs de la santé travaillant en Afrique et en Asie du Sud se sont réunis dans le cadre d'un atelier international afin d'examiner des technologies alimentaires applicables au niveau des ménages qui semblent prometteuses pour améliorer la nutrition des nourrissons et des jeunes enfants. Après avoir examiné les connaissances actuelles en matière d'allaitement au sein et les pratiques de sevrage en Afrique orientale et australe, les participants ont discuté de l'utilisation, au cours du sevrage, d'aliments fermentés et de farine germée, tant pour améliorer l'apport nutritionnel chez les jeunes enfants que pour diminuer les risques de contamination des aliments. Ils ont également discuté des recherches qu'il y aurait lieu d'entreprendre sur l'efficacité des technologies alimentaires et sur leur diffusion dans la collectivité.

Cette publication fait un compte rendu des discussions de l'atelier et présente ses conclusions et ses recommandations. Elle s'adresse aux scientifiques et aux planificateurs de la santé qui participent à des recherches en matière de nutrition et à l'élaboration de programmes visant à améliorer l'alimentation des nourrissons et des jeunes enfants dans les pays en développement.

Resumen

El período de destete, es decir, aquel período en la vida de un niño en que se introducen en su dieta alimentos suplementarios para complementar la leche materna, representa un gran riesgo nutricional para los niños de países en vías de desarrollo. Hacia el final de su segundo año de vida, un tercio de los niños en Africa oriental y del sur muestran señales de malnutrición crónica. Los siguientes factores contribuyen al crecimiento vacilante que se observa comúnmente en los niños que se encuentran en edad de dejar la lactancia materna: baja ingestión de nutrientes, alta incidencia de diarrea (a menudo causada por alimentos para el destete contaminados), y nuevas disminuciones en la duración e intensidad de la alimentación proveniente del pecho de la madre.

Científicos del campo de los alimentos, especialistas en nutrición y planificadores de la salud que trabajan en Africa y en el Sur de Asia se reunieron en un taller internacional para examinar las tecnologías de alimentos que se utilizan en el hogar y que prometen buenos resultados en el mejoramiento de la nutrición de lactantes y niños pequeños. Después de analizar el conocimiento que existe actualmente sobre la alimentación recibida a través del pecho de la madre y las prácticas que se utilizan para el destete en el oriente y sur de Africa, los participantes discutieron el uso en dietas para el destete de alimentos fermentados y harina germinada para que los niños pudan ingerir nutrientes mejorados y haya una disminución en el riesgo causado por la contaminación de los alimentos. Se identificó la investigación que se debe realizar sobre la efectividad de las tecnologías de alimentos y se discutió su difusión en el seno de la comunidad.

Esta publicación contiene las actas, conclusiones y recomendaciones del taller. Está dirigida a científicos y planificadores de la salud que participan en lainvestigación nutricional y en programas de desarrollo para mejorar la alimentación de lactantes y niños en los países en desarrollo.

CONTENTS

BACTERIOLOGICAL PROPERTIES OF TRADITIONAL SOUR PORRIDGES IN LESOTHO

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Abstract *The bacteriological properties of fermented sorghum porridge, or "motoho," were investigated at the Microbiology Department, Queen Elizabeth II Hospital, Maseru, Lesotho. The "motoho" was prepared from a starter obtained in Maseru. The porridge was inoculated with the pathogens (Shigella boydii, S. typhi, enteropathogenic Escherichia coli 0126 and Salmonella sp. nonenteric) before, during, and after fermentation. Unfermented sorghum porridge ("leshele-shele") was treated identically, as a control. The results showed the "motoho" to have an acidic property, produced during fermentation, that eliminated the pathogens within 3 h. Starters were also taken from four areas around Lesotho, and the batches of "motoho" inoculated with the pathogens. These pathogens were again eliminated within 3 h. Not only does "motoho" not support the growth of pathogens, but it is available locally and is inexpensive.*

Sorghum is a staple crop in many African countries, including Lesotho. Traditionally, it is used to prepare stiff porridge, thin porridge, and a wide range of fermented beverages, including local beer. In this study, emphasis is placed on the fermented, thin porridge known in Lesotho as "motoho," and on the unfermented porridge known as "leshele-shele." Both are popular as weaning porridges and as foods for young children.

"Motoho" can be consumed at any time of the day, both by children and by adults, and is prepared at the household level. On arrival at a home, one is offered "motoho" as a beverage; it serves as an alternative for the tea or coffee of European families. Because it keeps longer and can be prepared in large amounts for future use, it is preferred over "leshele-shele." "Motoho" can be taken to the fields without losing its texture or taste, and is therefore popular among agricultural workers. "Leshele-shele," on the other hand, soon becomes tasteless and loses its consistency.

"Leshele-shele" is eaten mainly by the urban population of Lesotho. It is served for breakfast and sometimes throughout the

day. It is quick and easy to prepare. "Motoho" is seldom prepared in the urban areas: it is considered old-fashioned by this sector of the population. "Leshele-shele" is also popular in the rural areas, however, especially with mothers who have just given birth: this unfermented porridge is believed to be extremely nutritious - an important factor for a lactating mother.

Preparation

"Motoho" is prepared by mixing fine-ground mealie (sorghum or maize flour) with lukewarm water. A bacterial culture, or "starter," is added to the preparation. This starter is usually obtained from a previous preparation. The mixture is wrapped in a blanket and left 11-13 h (usually overnight) to ferment. The following morning, a sieved mixture of the porridge is cooked in boiling water for about 20-30 min. Alternatively, in the villages, where grinding stones are still used, the mealie is ground very roughly, and after overnight incubation with the starter, is reground very finely and cooked as described. "Leshele-shele" is prepared by mixing a portion of fine-ground sorghum or maize flour mealie (either commercially prepared or locally ground) with water and boiling for 15 min to make a thin porridge.

Objectives

The objective of this project was to assess the ability of sour porridges to stop or retard the growth of pathogenic microorganisms that are responsible for causing diarrhea. The organisms investigated were Salmonella typhi, Salmonella sp. (nonenteric), enteropathogenic Escherichia coli 0126, and Shigella boydii. The unfermented porridge ("leshele-shele") was included for purposes of comparison, and nutrient broth was used as a control. The study also investigated the stage in the fermentation process at which the actual destruction of the pathogens occurs. Starters from different areas of Lesotho were tested for their ability to inhibit the growth of the bacteria.

Methodology

The following investigations were carried out:

- The cooked "motoho" and cooked "leshele-shele" were inoculated with similar dilutions of the above-mentioned microorganisms in ringers solution. They were incubated overnight at 37°C, then subcultured on MacConkey plates and, after 24 h, examined for growth.

- The uncooked "motoho" and uncooked "leshele-shele" were inoculated with dilutions of the microorganisms and incubated at 37°C. Subcultures on MacConkey plates were made after 1, 3, 6, and 9 h. These plates were incubated overnight and examined for growth.

- The uncooked "motoho" and uncooked "leshele-shele" were prepared and incubated at 37°C. After fermenting for 1, 3, and 6 h, the porridges were inoculated with dilutions of microorganisms.

They were subcultured after 1 h and after 3 h, and incubated at 37°C overnight to be examined for growth the following morning.

- "Motoho" was prepared in the laboratory using four different starters from various areas of Lesotho. These were cooked and inoculated with dilutions of microorganisms and incubated at 37°C. "Motoho" was subcultured after 3 and after 24 h on MacConkey plates. The plates were incubated overnight and examined for growth. "Leshele-shele" was similarly prepared and inoculated; the growth from "leshele-shele" was used as a control. Results are reported in colony counts, which were obtained by performing dilutions of 10^{-1} to 10^{-4}.

Discussion

Preparation and consumption of fermented sorghum porridge ("motoho") has been traditional in Lesotho. In this project, we have investigated the ability of "motoho" to inhibit the growth of certain diarrheal pathogens. There is no general agreement on methods for bacteriological examination of food; we have therefore chosen a general method for the estimation of the microbial content, i.e., "viable count."

We began our studies by inoculating "motoho" and "leshele-shele," as prepared in the home, with the pathogens. Both autoclaved and unautoclaved "motoho" effectively inhibited the growth of all the tested pathogenic bacteria. A few colonies of Salmonella at low dilution did, however, succeed in growing in the autoclaved "motoho." The "leshele-shele" had no inhibitory effect on the pathogens; in other words, it appears to have no antibacterial properties. The growth in all the dilutions was so confluent that it was impossible to count the colonies. Nutrient broth was used as a control, and it too yielded confluent growth. Autoclaving did not appear to influence results, either in "motoho" or in "leshele-shele." Thus we see that "motoho" has the ability to destroy those pathogens inoculated after fermentation has finished and the porridge cooked.

We then investigated at what stage of fermentation the inhibition of growth occurred. From Table 1, we see that the number of colonies in the "leshele-shele" was comparable to the number in "motoho" after a 1-h subculture. A comparison with the 3-h subculture shows that, whereas the pathogens in the "leshele-shele" continued to multiply, the pathogens in the "motoho" remained unchanged or decreased in number. In the 6-h and 9-h subcultures, the pathogens in the "leshele-shele" continued to multiply; those in the "motoho" were, however, completely eliminated, with the exception of a few colonies of enteropathogenic E. coli that grew on the 6-h subculture. The pH of the "leshele-shele" dropped from 7.1 to 7.0. The pH of the "motoho," however, decreased from 7.0 to 6.4; this suggests that an acid was being produced. The exposure time provided by 1 h of fermentation was not sufficient, however, to inhibit the growth of the pathogens.

The results seen in Table 2 were obtained when the pathogens were added to the "motoho" at intervals of 1, 3, and 6 h after fermentation had begun. It can be observed from the results that none of the pathogens was capable of surviving in the "motoho" 3 h after fermentation

Table 1. Number of colonies counted when uncooked "motoho" and uncooked "leshele-shele" were inoculated with the organisms and subcultured after 1, 3, 6, and 9 h.

	1 h	3 h	6 h	9 h
"Motoho"[a]				
Shigella boydii	24500	28000	0	0
Salmonella typhi	38000	40000	0	0
E. coli	2600	1800	40	0
Salmonella sp.	57000	850	0	0
"Leshele-shele"[b]				
Shigella boydii	26000	60000	200000	220000
Salmonella typhi	37000	110000	250000	300000
E. coli	2800	26000	600000	1000000
Salmonella sp.	59500	120000	2000000	3000000

[a]pH measured during fermentation was: 6.6, 6.5, 6.4, and 6.4 at 1, 3, 6, and 9 h, respectively.
[b]pH measured during fermentation was: 7.1, 7.0, 7.0, and 7.0 at 1, 3, 6, and 9 h, respectively.

Table 2. Number of colonies counted when uncooked "motoho" and "leshele-shele" were inoculated with similar dilutions of organisms at intervals of 1, 3, and 6 h and subcultured after 1 and 3 h.

	1-h inoculation		3-h inoculation		6-h inoculation	
	1-h SC[a]	3-h SC	1-h SC	3-h SC	1-h SC	3-h SC
"Motoho"						
Shigella	1500	0	0	0	0	0
Salmonella typhi	2500	0	7500	0	0	0
E. coli	30000	0	2000	0	0	0
Salmonella sp.	50000	0	0	0	0	0
"Leshele-shele"						
Shigella	1400	160000	3200	300000	3000	400000
Salmonella typhi	3300	30000	7000	200000	5000	200000
E. coli	140000		_[b]	_[b]	_[b]	_[b]
Salmonella sp.	200000	$3x10^6$	320000	$8x10^6$	340000	$20x10^6$

[a]SC = subculture.
[b]No figures available due to contamination.

had occurred. The pH tolerance of the microorganisms tested is 7.2 to 7.6; the pH levels of the "motoho" may therefore be responsible for the death of these pathogens.

Table 3 shows that the starters from different areas of Lesotho were equally effective in eliminating all the pathogens within 3 h. The pathogens in the "leshele-shele" showed a confluent growth after 24 h, whereas no pathogens survived in the "motoho."

Table 3. Number of colonies counted when "motoho" was prepared from four different starters, cooked, and inoculated with dilutions of microorganisms.

	"Motoho"				"Leshele shele"[b]
	S[a]	Q	M	C	
Subcultured after 3 h					
Shigella boydii	0	0	0	0	20000
Salmonella typhi	0	0	0	0	0
E. coli	$2x10^6$	25000	65000	26000	$3x10^6$
Salmonella sp.	0	0	0	0	0
Subcultured after 24 h					
Shigella boydii	0	0	0	0	Confluent
Salmonella typhi	0	0	0	0	"
E. coli	0	0	0	0	"
Salmonella sp.	0	0	0	0	"

[a]S, Semonkong; Q, Quthing; M, Maseru; C, Caledon.
[b]"Leshele-shele" was treated similarly and used as a control.

We had hoped that, given an inoculation of the appropriate dose of diarrheal pathogen, we would, after 3 h incubation, obtain 400 organisms of Shigella boydii and S. typhi and a million organisms of Salmonella sp. and E. coli 0126. After trying various dilutions, we found that it was impossible to achieve this. It would be interesting to know whether inoculation at the appropriate dose, as opposed to a higher dose (as in our context), would have changed the outcome.

Conclusion

Tables 1-3 show that fermented sorghum porridge ("motoho") becomes acidic, and that Shigella boydii, S. typhi, enteropathogenic E. coli 0126, and Salmonella sp. (bacterial pathogens likely to cause diarrhea) are unable to survive in such a medium.

Sorghum is locally available in Lesotho and grows on both highlands and lowlands. Because of the work involved in cultivating the crop, however, sorghum is not cultivated to the same extent today as it was 10 years ago. Ground sorghum may be purchased at local stores and is inexpensive. The method of fermenting the sorghum is uncomplicated and results in a more palatable porridge.

It is indicated by the tests conducted in this study that "motoho" is capable of inhibiting the growth of certain microorganisms, and that this capability arises from the creation, during fermentation, of a low pH. Porridges become contaminated at the initial stages of preparation by impure water or when microbes are transferred from the hands of food handlers (Tompkins et al., this volume). Hot weather could also contribute to a high level of contamination occurring between preparation and consumption. Because "motoho" is capable of destroying certain diarrhea-causing microorganisms, it appears safer to recommend this porridge, rather than unfermented porridge, as a weaning food for young children.