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REVIEW/DERLEME

Microbiological Quality And Antibiotic Resistance Of Home-Made And Commercial Infant Foods: A Comparative Pilot Study

Ev Yapım Ve Ticari Bebek Gıdalarının Mikrobiyolojik Kalitesi Ve Antibiyotik Direnci: Karşılaştırmalı Bir Ön Çalışma

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Abstract

Aim: This study aims to perform microbiological analyses of commercial and homemade infant formulas used in complementary infant feeding and to determine the antibiotic resistance profiles of pathogenic bacteria isolated from these formulas.

Materials and Methods: Samples were taken from various homemade and commercially available infant formulas. The microbial content and antibiotic resistance profiles of the isolated pathogenic strains were analyzed using standard microbiological methods.

Results: The study found that the microbiological quality of homemade infant formulas was lower compared to commercial formulas. It was observed that the microbiological quality of infant formulas was significantly affected by prolonged storage. Notably, the presence of pathogenic bacteria with multiple antibiotic resistances was detected in some samples, indicating potential health risks for infants.

Conclusion: The study highlights the importance of microbiological safety in the preparation and selection of infant formulas. Additionally, the emergence of multi-antibiotic resistant bacteria underscores the necessity for increased awareness and the establishment of stringent standards.

Keywords: Home-made İnfant foods, Microbiological quality, Antibiotic resistance

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Öz

Giriş: Bu çalışmada tamamlayıcı bebek beslenmesinde kullanılan, ticari ve ev koşullarında hazırlanmış bebek mamalarının mikrobiyolojik analizlerinin yapılması ve mamalardan izole edilen patojen bakterilerin antibiyotik direnç profillerinin belirlenmesi amaçlanmıştır.

Gereç ve Yöntem: Hem ev yapımı hem de ticari olarak mevcut olan çeşitli bebek mamalarından örnekler alınmış ve standart mikrobiyolojik yöntemler kullanılarak mikrobiyal içerik ve elde edilen patojen izolatların antibiyotik direnç profilleri analiz edilmiştir.

Bulgular: Çalışmada, ev yapımı bebek mamalarının ticari mamalara göre mikrobiyolojik kalitesinin daha düşük olduğu tespit edilmiştir. Bebek mamalarının mikrobiyolojik kalitesinin uzun süreli depolamanın sonunda önemli ölçüde etkilendiği gözlemlenmiştir. Özellikle, bazı örneklerde çoklu antibiyotik direncine sahip patojen bakterilerin varlığı tespit edilmiştir, bu da bebekler için potansiyel sağlık risklerini göstermektedir.

Sonuç: Çalışma, bebek mamalarının hazırlanması ve seçiminde mikrobiyolojik güvenliğin önemini ayrıca ortaya çıkan çoklu antibiyotik direnç verileri göz önüne alınarak daha iyi bir farkındalık ile standartların gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Ev yapımı bebek gıdaları, Mikrobiyolojik kalite, Antibiyotik direnci

INRODUCTION

Poor and insufficient nutrition can lead to malnutrition which in turn places infants at serious risk regarding infectious diseases (1,2). To illustrate the grave reality of this situation, approximately 3.1 million infants die each year as a result of malnutrition and infectious disease related conditions (3).

Malnutrition is caused by a multitude of factors, including broad social and environmental elements such as economic conditions, access to healthcare, and educational levels. Within these general factors, particularly noteworthy is the shift in lifestyle, especially how the increased participation of women in the workforce is leading to shorter breastfeeding periods (4). To offset shorter breastfeeding periods, mothers often resort to using complementary infant foods, both commercially produced and traditional homemade varieties (5). This trend is especially prevalent in low-income and undeveloped countries, where such coping strategies are common, leading to a preference for preparing traditional homemade complementary infant foods (6).

Complementary foods cannot be completely sterilized while preserving their organoleptic qualities. As a result, these foods can create an environment conducive to the growth of harmful microorganisms (7,8). According to UNICEF, the assessment of the microbiological quality of infant foods should initially focus on total aerobic bacteria, enterobacteria, *S. aureus*, and molds (9). Conversely, the Microbiological

Criteria Regulation stipulates that priority should be given to examining *B. cereus*, Salmonella spp., *L. monocytogenes*, and Enterobacteriaceae (10).

With the transition from breastfeeding to complementary feeding, there is an increased risk of infectious diseases due to contamination, especially by pathogenic microorganisms in foods (11,15). Contamination can occur during the production, storage, or preparation of food when necessary hygiene conditions are not met or maintained (16,17) Moreover, uncontrolled contamination can lead to the development of antibiotic resistance in microorganisms in foods. This can result in gene transfer in the intestines and the emergence of antibiotic-resistant bacterial strains (18). In infants, whose microbiota is still developing, the presence of antibiotic-resistant pathogenic microorganisms in their diet can adversely affect the development of their microbiota and cause recurrent diarrhea. Implementing basic precautions, such as washing hands with soap during the preparation of foods, can have a significant impact; for instance, it can prevent 47% of diarrheal cases linked to food contamination (19).

In this context, the microbiological safety and quality of the foods consumed in infant nutrition are of great importance. This study aims to conduct microbiological analyses of commercially available and home-made foods used in complementary feeding, both at the point of consumption and after different storage durations at home. It also intends to detect the presence of pathogenic bacteria in these foods and determine the development of antibiotic resistance in the isolates obtained.

MATERIALS AND METHODS

Sampling:

In this study, ten different foods, which are consumed during the complementary feeding period, were used. The selection included five commercial products consisting of two different spoon-feeding purees and three jarred baby foods, as well as five homemade baby food recipes. Commercial products were purchased in sealed and unspoiled packages as recommended in stores, while ingredients for homemade baby foods were randomly sourced from selected greengrocers and supermarkets. The prepared foods were made under aseptic conditions simulating a home/hospital environment according to the recipes detailed in Table 2. All prepared and purchased baby food samples (n=10) were preserved at +4 °C until microbiological analysis (Table 1).

Table 1. Selected Complementary Baby Foods for Use in the Study

Sample No	Home-made Baby Foods	Sample No	Commercial Baby Foods
1	Breakfast Sample	2	Milk, Cheese, and Molasses Spoon Food
3	Vegetable Puree	4	Garden Vegetables Jar Food
5	Rice Flour Pudding	6	Organic Rice Pudding Jar Food
7	Fruit Puree	8	Milk, Oat, and Wheat Spoon Food
9	Vegetable Soup	10	Mixed Fruit Jar Food

Table 2. Content and Recipes of Homemade Complementary Baby Foods

Home Made Baby Foods	Ingredients	Quantity	Unit	Gram	Recipe
Breakfast Sample	Milk	1/2	Package	100mL	Pour milk into a clean bowl. Add 7 baby biscuits, crush them, then add cheese and crush again. Finally, add molasses. Serve in a serving dish.
	Molasses	1	Teaspoon	5gr	
	Cheese	1	Teaspoon	8gr	
	Breakfast Cici Bebe Biscuits	7 pieces		28gr	
Fruit Puree	Pear (peeled)	1/2	Small-sized	81	Wash apples and pears thoroughly. Cut in half, peel, and divide into 3-4 pieces. Grate with a glass grater.
	Fruit Puree - Apple	1/2	Small-sized	63	
	Sugar	1	Teaspoon	8gr	
Rice Flour Pudding	Milk	1	Package	200mL	Pour cold milk into a clean pot. Add rice flour, mix well, and cook slowly over heat. After removing from heat, add sugar.
	Rice Flour Pudding - Rice Flour	1	Teaspoon	8gr	
Veg etable Soup	Water	2,5	Water glass	500	Wash, peel, and chop carrots, zucchini, and potatoes. Place the vegetables in a pot and cover with water. Bring to a boil and cook until soft. After cooking, add semolina and olive oil, boil for 2-3 minutes. Blend the soup and serve.
	Olive Oil	1	Teaspoon	8gr	
	Semolina	1	Tablespoon	10gr	
	Zucchini	1piece	Small-sized	100gr	
	Potato	1 piece	Small-sized	100gr	
	Vegetable Soup - Carrot	1 piece	Small-sized	25gr	
Vegetable Puree	Water	2	Water glass	400mL	Carrots and potatoes are washed, peeled, and chopped. Boil them in a pot with two glasses of water until soft. Mash them into a puree with a fork.
	Carrot	1 piece	Small-sized	25gr	
	Potato	1 piece	Small-sized	100gr	

Microbial Analysis:

In the study, samples were analyzed for Total Mesophilic Aerobic Bacteria (TMAB), Total Yeast and Mold (TYMC), Total Psychrophilic Aerobic Bacteria (TPAB), and Enterobacteriaceae bacterial loads using the spread plate method. Plate Count Agar (PCA) was used for TMAB and TPAB, Potato Dextrose Agar (PDA) for Total Yeast and Mold, and Eosin Methylene Blue Agar (EMB) for Enterobacteriaceae. The inoculated petri dishes were incubated at 37 °C for 18-24 hours, at +4 °C for 7 days, and at 27 °C and 37 °C for 18-24 hours respectively. Microbial counts of samples kept at +4 °C were repeated after 24 and 48 hours (20).

Identification of Isolates and Determination of Their Antibiotic Resistance Profiles:

Bacteria with different colony morphologies were purified using the streak plate method. The obtained isolates were then subjected to a series of tests including Gram staining, catalase, oxidase tests, IMVIC tests, Carbohydrate tests, Motility test, H_2S, Urease test, Egg yolk reaction, and tests for growth in an anaerobic environment (20).

Following their identification, the antibiotic susceptibility and resistance profiles of these isolates were determined using the disk diffusion method recommended by the Clinical and Laboratory Standards Institute (CLSI, 2011). For this purpose, commercial antibiotic disks such as Tetracycline (TE 30µg), Colistin (CT 10µg), Cefoxitin (FOX 30µg), Gentamicin (CN 10µg), Ampicillin (AM 2µg), and Penicillin (P 10 U) were utilized.

RESULT

Table 3 compares the physical and sensory properties of homemade and commercial baby foods under storage conditions at +4 °C. The parameters evaluated are color, odor, appearance, and physical characteristics, observed at 24- and 48-hours post-storage. Various physical changes were observed in the samples subjected to microbiological analysis from the initial preparation time up to the end of the 48th hour. Notably, the sample of homemade fruit puree, which is most preferred by mothers, underwent the most significant changes in terms of color, smell, and appearance.

Table 3. Comparison of Physical and Sensory Properties of Homemade and Commercial Baby Foods Under +4 °C Storage Conditions

Storage Time	24. Hours				48. Hours			
Sample No	Color	Odor	Apperance	Pyhsical Characteristics	Color	Odor	Apperance	Pyhsical Characteristics
1	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	C
4	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N
7	N	N	N	N	C	C	C	N
8	N	N	N	N	N	N	C	C
9	N	N	N	N	N	C	N	C
10	N	N	N	N	N	C	N	N

N= Normally C=Change has been observed

Table 4 illustrates the microbial load in homemade and commercial baby foods at the time of consumption and following storage. It presents the counts of Total Mesophilic Aerobic Bacteria (TMAB) among other microorganisms for various samples. The data demonstrates an increase in microbial load over time, indicating the impact of storage conditions on the microbiological quality of the foods. This increase emphasizes the importance of appropriate storage practices and the potential risk of extended storage periods on the microbial safety of baby foods.

Table 4. Microbial Load at the Time of Consumption and After Storage in Commercial and Homemade Baby Foods

Microorganisms		TMAB			Enterobacteriaceae			TPAB			TYMC		
Sample Number/ Storage Period		0.Hours	24. Hours	48. Hours	0.Hours	24. Hours	48. Hours	0.Hours	24. Hours	48. Hours	0.Hours	24. Hours	48. Hours
1	**Home-made**	$6,5x10^3$	$1,1x10^5$	$5,1x10^8$	**$6,9x10^3$***	$2,0x10^4$	$1,3x10^8$	$4,5x10^5$	$1,1x10^7$	TNTC	$3,0x10^5$	$4,8x10^5$	$1,7x10^8$
2	**Commercial**	$3,0x10^5$	$3,0x10^6$	$7,4x10^4$	$3,0x10^5$	$1,0x10^5$	$1,1x10^6$	$6x10^5$	$7,5x10^7$		$3,0x10^5$	$1,3x10^7$	$4,0x10^5$
3	**Home-made**	$2,4x10^5$	$1,0x10^7$	$3,0x10^9$	$2,0x10^4$	$3,0x10^7$	$3,0x10^9$	$1,9x10^4$	$1,5x10^7$		$3,9x10^4$	$4,0x10^7$	$2,4x10^9$
4	**Commercial**	$3,0x10^5$	$1,4x10^8$	$1,2x10^8$	$4,4x10^4$	$7,1x10^6$	$1,0x10^7$	$8,2x10^4$	$3,0x10^6$		$3,0x10^4$	$4,0x10^8$	$1,5x10^7$
5	**Home-made**	$4,1x10^4$	$3,5x10^4$	$3,0x10^9$	$5,4x10^3$	**$2,3x10^5$**	$3,0x10^9$	$3,5x10^4$	$3,0x10^9$		$2,0x10^4$	$2,0x10^8$	**$3,0x10^9$**
6	**Commercial**	$3,0x10^5$	$7,1x10^7$	$3,0x10^9$	$3,0x10^5$	$3,0x10^7$	$3,0x10^8$	$3,0x10^3$	$3,0x10^6$		$1,9x10^5$	$5,1x10^7$	$2,9x10^9$
7	**Home-made**	-	$6,4x10^7$	$2,7x10^8$	-	**$4,7x10^5$***	$3,0x10^9$	$7,7x10^2$	$3,0x10^6$		$2,0x10^3$	$3,0x10^6$	**$9,6x10^4$**
8	**Commercial**	$6,3x10^4$	$5,3x10^7$	$1,3x10^9$	$3,0x10^5$	$1,5x10^5$	$9x10^8$	$1,8x10^4$	$6,2x10^6$		$1,2x10^6$	**$1,2x10^8$**	$1,0x10^9$
9	**Home-made**	$3,0x10^5$	$7,4x10^7$	$5,5x10^8$	$9,2x10^3$	$3,0x10^8$	$7,7x10^8$	$1,5x10^4$	$2,0x10^6$		$1,6x10^4$	$1,9x10^8$	$3,0x10^8$
10	**Commercial**	$3,0x10^5$	$2,6x10^6$	$1,3x10^8$	$5,5x10^4$	$3,0x10^7$	$3,0x10^9$	$1,0x10^5$	$1,2x10^8$		$3,3x10^4$	$1,1x10^6$	$3,0x10^9$

TMAB: Total Mesophilic Aerobic Bacteria, TYMC: Total Yeast and Mold, TPAB: Total Psychrophilic Aerobic Bacteria , TNTC : Too Numerous To Count, * Suspected E coli

Table 5. Antibiotic Resistance Profiles of Identified Pathogenic Bacteria

		Diameter zone (mm)					
İzolate Number	**Identified Species**	FOX 30 µg	AM 2 µg	TE 30 µg	CT 10 µg	CN 10 µg	P 10 U
1	*Bacillus cereus*	23 (S)	NT	22 (S)	8 (R)	20 (S)	9 (R)
2	*Escherichia coli*	0 (R)	0 (R)	0 (R)	0 (R)	NT	NT
3	*Yersinia spp.*	32 (S)	14 (S)	0 (R)	10 (R)	NT	NT
4	*Providencia rettgeri*	22 (S)	7 (R)	24 (S)	12 (R)	NT	NT
5	*Escherichia coli*	20 (S)	13 (R)	20 (S)	0 (R)	NT	NT
6	*Escherichia coli*	21 (S)	8 (R)	21 (S)	10 (R)	NT	NT

NT = No Test R: Resistant S: Sensitive Tetracycline (TE 30µg), Colistin (CT 10µg), Cefoxitin (FOX 30µg), Gentamicin (CN 10µg), Ampicillin (AM 2µg), and Penicillin (P 10 U)

This table (Table 5) focuses on the antibiotic resistance profiles of pathogenic bacteria isolated from the baby food samples. It includes details such as isolate codes, identified bacterial species, and their resistance patterns against a range of antibiotics (e.g., Cefoxitin, Ampicillin, Tetracycline). The diameter of inhibition zones in millimeters is used to indicate the level of bacterial resistance. This analysis is crucial for understanding the potential health risks posed by these pathogens and informs strategies for effective antibiotic use in addressing foodborne illnesses.

DISCUSSION

The microbiological safety of foods and baby foods, especially those used in complementary feeding, is crucial as babies and children are more sensitive to pathogenic microorganisms. In our study, we first determined and compared the microbiological quality of homemade baby foods and commercial baby foods containing equivalent food items. In addition, considering the consumption moment and the storage period by caregivers of the remaining baby foods, the organoleptic properties and changes in microbial load were identified in samples stored at +4°C for 24 and 48 hours. The results obtained in the study are presented in Table 3 and Table 4 respectively.

Accordingly, the study found that at the time of consumption, both homemade and commercially available foods were examined for color, smell, appearance, and physical control, and all were found to be normal. However, after 24 hours, all organoleptic properties of the examined samples remained normal; after 48 hours, changes were observed in the physical properties of the third sample of homemade foods, color, smell, and appearance of the seventh sample, and smell and physical condition of the ninth sample. For commercially available foods, including Milk Oat Wheat Spoon Food, changes in appearance and physical properties were observed. This indicates that the organoleptic properties of homemade baby foods are more prone to alteration compared to commercially available ones.

One of the most important parameters indicating the microbiological quality of food items is the Total Mesophilic Aerobic Bacteria (TMAB) and the Total Yeast and Mold load. High values of these parameters provide information about the hygienic status of the food. On the other hand, high TMAB values indicate the presence of pathogenic bacteria (21), while high Total Yeast and Mold values can have negative health impacts (22). In our study, the TMAB load of homemade foods at the time of consumption ranged between $6.5x10^3$-$3.0x10^5$ CFU/g, while for commercial baby foods, it ranged between $6.3x10^4$-$3.0x10^5$ CFU/g. According to both the Codex Alimentarius (23) and the Turkish Food Codex (2009), the TMAB load (total bacterial count) should not exceed 10^3 CFU/g. The TMAB load, being an indicator of hygiene, suggests that the consumption of complementary baby foods exceeding this limit is not recommended. Accordingly, at the time of consumption, 40% of the examined baby foods were within consumable limits, while 60% exceeded these limits. Notably, all commercial food bacterial load values were above consumable limits. Parallel to our study, a 2009 study by Kung et al. on home-prepared traditional complementary foods reported that 71.7% of the 120 samples examined were not suitable for consumption in terms of TMAB (24). Furthermore, studies on the microbiological quality of both baby foods and traditional baby foods have indicated that these products are conducive environments for microbial growth, particularly in grain mixtures and bottle foods, posing a high risk of microbial spoilage (25,26). Our study observed that changes in organoleptic properties began after 48 hours of storage at +4°C, but 90% of the samples had microbiological counts exceeding 10^4 CFU/g based on the 24 and 48-hour data. Thus, as the periodic cold storage duration increased, even though the foods maintained their organoleptic properties, there was an increase in microorganism numbers; however, the bacterial load of the fifth sample at 24 hours remained within consumable limits. After 48 hours, the microbial load of samples 1, 4, 5, and 6, which maintained their organoleptic properties, was determined to be well above consumable limits. Therefore, it is important that both homemade and commercial baby foods be consumed immediately after preparation and not stored even for short periods like 24 hours in the refrigerator. The role of parents in providing microbiologically safe nutrition to babies is critically important. Particularly, contamination of foods with pathogenic bacteria in the home environment can be overlooked, thus requiring additional precautions. Especially animal-derived foods, which can cause infections and even death in babies, must be cooked at appropriate temperatures and durations (27). Home-prepared or commercially produced foods, once opened, should be consumed fresh and, if necessary, stored in the refrigerator (+4°C) for no more than two hours.

When examining the Total Yeast and Mold data from the studied microorganism groups, it was determined that there was no mold development in the samples and the colonies obtained were yeasts. Accordingly, the Total Yeast and Mold load in homemade foods at the time of consumption ranged between $2.0x10^{3}$-$3x10^{5}$, while in commercial foods, it ranged between $3.0x10^{4-}1.2x10^{6}$. According to the Turkish Food Codex Infant Formula Notification (2008), the Total Yeast and Mold (TYMC) load per gram should not exceed 10^{2} CFU/g. Therefore, both homemade and commercial baby formulas examined in the study did not meet this criterion. It was observed that the Total Yeast and Mold load increased in both homemade and commercial baby formulas after 24 and 48 hours. Studies suggest that the Total Yeast and Mold load detected in formulas may have developed due to improper storage conditions of raw materials during production or contamination during preparation (28,29). Therefore, it can be said that to minimize the risk of Total Yeast and Mold contamination, especially in homemade baby foods, the ingredients used should be stored under appropriate conditions, thoroughly washed before preparation, and hygiene rules should be followed during preparation.

Another parameter examined in determining the microbiological quality of baby foods is the Enterobacteriaceae family. The Enterobacteriaceae load in homemade samples at the time of consumption ranged between $5.4x10^{3-}2.0x10^{4}$; in commercial baby formulas, it ranged between $4.4x10^{4}$-$3.0x10^{5}$. After 24 hours, the number in homemade baby formulas increased to the range of 10^{4}-10^{8}, and after 48 hours, it rose to 10^{8}-10^{9}. The results indicate that the bacterial load increases logarithmically over time. (30), stated that bacteria belonging to the Enterobacteriaceae group are responsible for approximately 50% of septicemia cases, 70% of urinary system infections, and a high rate of intestinal infections, as well as life-threatening infections such as pneumonia, abscesses, and meningitis. Additionally, in our study, when comparing homemade and commercial formulas in terms of Enterobacter load, it was observed that commercial formulas carried a higher microbial load, while suspicious *E. coli* growth was detected in samples 1 and 7 of the homemade formulas. Subsequent identification confirmed unwanted *E. coli* contamination in homemade formulas. This situation is thought to stem from inadequate sanitation conditions in commercial formula production areas; in home-prepared baby foods, it may originate from the kitchen,

kitchen utensils, and ingredients like water, milk, etc., as well as from the personal hygiene of the parent preparing the food. Therefore, during the preparation of baby food at home, the sanitation of hands, utensils used in preparation, the kitchen, and the ingredients included in the formula is of significant importance. Indeed, Curtis (2003) in his study reported that washing hands with soap during formula preparation prevented 47% of diarrhea cases related to food contamination.

When the samples were evaluated in terms of Psychrophilic bacteria load, it was found that in homemade samples, the bacterial load at the time of consumption ranged between $7.7x10^2$-$4.5x10^5$; in commercial baby formulas, it ranged between $3.0x10^3$-$6.0x10^5$. After 24 hours, the bacterial load in homemade baby formulas increased to a maximum of 10^9, and after 48 hours, it was too high to count in the dilutions used in the study. While a high TMAB count in foods indicates a high risk of spoilage, high TPAB values indicate inadequacies in storage conditions. Therefore, both homemade and commercial baby formulas should not be stored for a long period after consumption, even at +4°C.

In the study, particularly colonies suspected of being *E. coli*, along with different colonies obtained from samples at the time of consumption, were selected and isolated. The isolated colonies were purified and 16 isolates were obtained. These isolates were identified through biochemical tests. Eleven Gram-positive and five Gram-negative bacteria were isolated in the study. 56% of the identified isolates were found to belong to the Bacillus genus. The presence of pathogenic bacteria such as *Bacillus cereus, Escherichia coli,* and Yersinia spp. among the identified isolates is noteworthy. Additionally, the resistance profiles of the identified pathogenic bacteria were determined (Table 5), and it was found that all bacteria had developed resistance to important antibiotic groups such as Colistin, which is considered a significant finding. Vural and Genç (2022) in their study evaluating baby formulas, follow-on formulas, and some complementary foods in terms of microbiological quality, reported that the pathogenic microorganisms obtained from the samples showed multiple resistance to three or more antibiotics, which is of public health significance. Particularly, the multiple resistance shown by pathogenic bacteria detected in homemade formulas is also significant. Most studies focus on commercial products; however, data from our study suggest that large-scale studies are needed to determine the microbiological quality of homemade baby foods.

CONCLUSION

As a result of this study, it has been determined that baby foods, whether prepared at home or produced commercially, should be consumed within 24 hours after the package is opened or after being freshly prepared at home, regardless of how properly they are stored. The importance of preparing and serving foods used in complementary feeding in compliance with general hygiene rules at every point has been supported for the successful continuation of infant nutrition. Globally, morbidity and mortality are most commonly observed during the transition period to complementary feeding. Therefore, it is of great importance to inform and educate caregivers about complementary feeding.

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