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Determination of the Bacteriological Quality of Weaning Porridges and Purees Consumed by Children Aged 6 to 24 Months at the Guinea Institute of Nutrition and Child Health

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Abstract

The feeding of children during weaning must be of good quality, this is essential, and it must not be a source of contamination to ensure the well-being of children. The objective of this work was to determine the bacteriological quality of the porridges and purees of weaning consumed by children from 6 to 24 months at the INSE of Guinea. For this, a descriptive study of analytical type was carried out over a period of 4 months at the INSE of Guinea. This study found that total mesophilic flora, faecal streptococci, staphylococci, and salmonella were consistent with sanitary standards in Plantin-enriched peanut paste and groundnut paste samples. They had respective bacteriological qualities of 90% and 60%. Fecal coliform contamination and ASR were observed respectively in the samples of rice husk remnants enriched with peanut paste and planting banana purée with respective values 50% and 40%. From the point of view of tampering, the samples of rice ground meal enriched with groundnut paste and Plantin banana purees were severely affected by the total coliforms at 40% and 60% respectively. In the end, poor hygiene practice during preparation increases the risk of food contamination; however, hygienic measures must be taken to improve the hygienic quality of food to maintain good health of children.

Keywords

Bacteriological Quality, Porridges, Purees, INSE of Guinea

1. Introduction

The availability of wholesome, nutritious food is one of the fundamental rights of the human being, and an essential factor in maintaining an adequate state of health [1].

Food safety is, therefore, an increasingly important public health issue. For this reason, ensuring the safety and protection of consumers against food-borne illness has become a major global concern [2].

Food-borne illnesses are generally infectious or toxic in nature, caused by bacteria, viruses, parasites or chemicals that enter the body through contaminated food or water. Contaminated food is generally responsible for a significant proportion of illnesses, particularly diarrhea in infants and young children, especially in developing countries [3].

It is estimated that 2 billion episodes of diarrhea occur each year in children under 5 years of age, resulting in over 1.5 million deaths worldwide [4].

The highest prevalences are found in low-income and middle-income countries (LMIC), grouped around those aged 6 to 24 months [5].

Microbial contamination leading to infections and nutrients associated with weaning foods could contribute significantly to the deaths of 13 million infants and children under five worldwide every year [5] [6].

After respiratory infections, diarrhoeal diseases are the most common and have the greatest negative impact on the growth of infants and young children [7] [8].

The importance of food safety in preventing diarrhoeal disease is often overlooked. Strategies to prevent diarrhoeal disease are often limited to promoting breastfeeding or improving water supply and sanitation, overlooking the need to educate food handlers, particularly mothers, about food safety [9]-[13].

In Côte d'Ivoire, as in most developing countries, the industrial supplementary foods for children sold in supermarkets and large retailers are inaccessible to a large part of the population, as they are sold at very high prices. Traditional infant flours, homemade porridges and weaning purées, available to all, have very low nutritional value and cause problems of malnutrition, nutritional deficiencies and certain diarrhoeal diseases [14].

However, [13]-[15], found that an intervention developed using a HACCP (Hazard Analysis Critical Control Point) approach was highly effective in reducing contamination of home-cooked weaning foods in periurban Mali.

Follow-up formula for second-age infants intended to form the liquid or semi-solid part of the diet of second-age infants as part of the introduction of a progressively diversified supplementary diet and the production of a wholesome, quality complementary food porridge or weaning purées meeting international criteria requires technical skill and expertise in taking into account a number of technological, microbiological and nutritional parameters [16].

Kamardine Abdou in 2019 in Guinea reported 70% satisfactory bacteriological quality in all milk porridge samples on Determination of the bacteriological quality of collective catering porridges and purees consumed by children aged 6 - 59

months at the Jean Paul II nursery school and day-care center in Taouyah [17].

The SMART (Standardized Monitoring and Assessment of Relief and Transition) survey of infant and young child feeding practices in the Republic of Guinea determined the level of key indicators such as exclusive breastfeeding, with a national prevalence of 43.7%; early breastfeeding, with a national prevalence of 25.8%; dietary diversity, with a prevalence of 11.1%; and the proportion of children benefiting from an acceptable minimum diet, with a prevalence of 4.2%. (SMART, 2022) [18].

In the Republic of Guinea, the SMART survey also assessed the prevalence of childhood morbidities such as: fever (39.8%), diarrhea (14.7%) and ARI (43.1%). (SMART, 2022) [19].

Infants and babies are more susceptible to infection by food-borne pathogens due to their less developed immune systems and the absence of competing organisms in the intestinal flora [20].

With the aim of assessing the bacteriological quality of porridges and purées prepared at the Guinea Institute of Nutrition and Child Health, and to combat unsanitary preparation of weaning foods, we have chosen to deal with this topic entitled: Determination of the bacteriological quality of weaning porridges and purees consumed by children aged 6 to 24 months at the Guinea Institute of Nutrition and Child Health. In order to carry out this work, we have set ourselves the following objectives.

General objective

To determine the bacteriological quality of weaning porridges and purées consumed by children aged 6 to 24 months at the Guinea Institute of Nutrition and Child Health.

Specific objectives

-Determine the preparation techniques for porridges and purées consumed by children aged 6 to 24 months.

-Research and enumerate the micro-organisms contained in weaning porridges and purées.

-Propose hygienic measures to reduce pathogenic risks associated with the preparation of weaning porridges and purées.

2. Materials and Working Methods

2.1. Place of Study (City of Conakry)

Conakry is the capital of the Republic of Guinea. It is located on the Atlantic Ocean. The Republic of Guinea is a West African country covering an area of 245,857 km^2. It is bounded by the Atlantic Ocean to the west, and shares borders with six countries: Guinea-Bissau to the northwest, Senegal to the north, Mali to the north and northeast, Ivory Coast to the east, and Liberia and Sierra Leone to the south [16]. Conakry is a 308 km^2 peninsula, 34 km long and 1 to 6 km wide. In 2015, the Conakry metropolitan area had a population of over 3 million, with a density of 81,151 inhabitants per km^2, making it the country's largest city. (**Figure 1**)

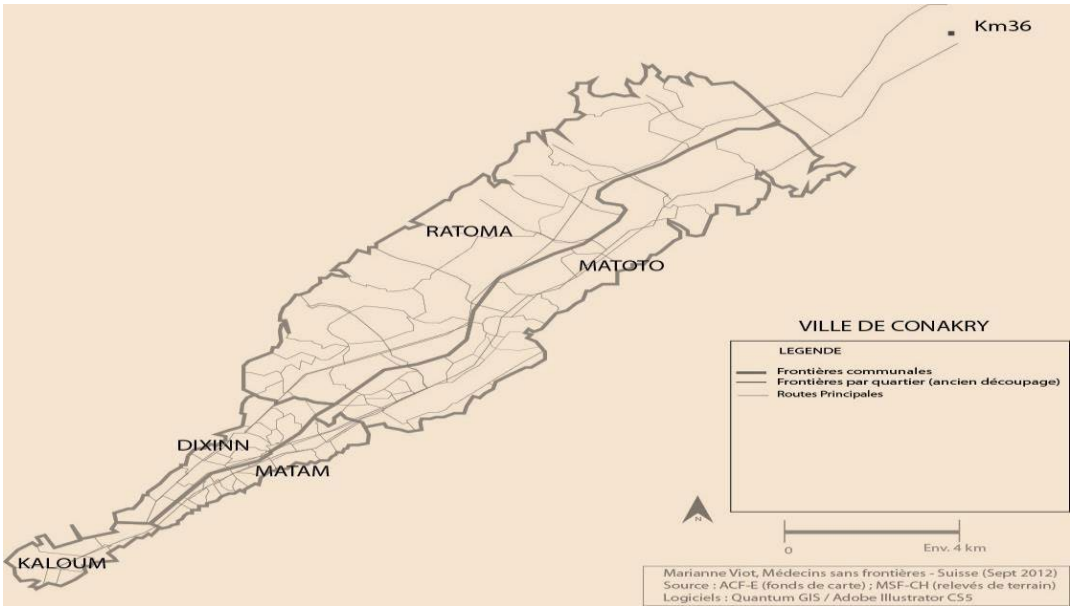

Figure 1. Geographical map of the city of Conakry [21]. (Marianne Viot 2012)

2.2. Study Setting (INSE, ONCQ)

The Guinea Institute of Nutrition and Child Health (INSE) and the Office National de Control de Quality served as the setting for this study.

2.3. INSE (Guinea Institute of Nutrition and Child Health)

Located within the Donka National Hospital, it was created on October 16, 1989, with the aim of:

-Provide specialized care for at-risk newborns, sick children in general and those with nutritional problems in particular.

-Conduct applied research in the field of nutrition and child health.

-Provide training for child health personnel.

-To promote scientific popularization in the field of nutrition and neonatology.

2.4. ONCQ (Matoto National Quality Control Office)

The Office National de Control de Quality (ONCQ) is located in the commune of Matoto, in the Khabitaya district. It is a public establishment of a scientific and technical nature, with legal personality and financial and management autonomy. It is placed under the supervision of the Ministry of Commerce, and its mission is to monitor the application of regulations relating to the quality of consumer goods in the Republic of Guinea. In particular, it is responsible for:

-Developing and implementing quality control programs.

-Help set up a national system for monitoring food quality and safety.

-Carry out quality control of goods and products for import and export.

-Ensuring compliance with current hygiene and commercial quality standards (products of plant and animal origin, fish products, cosmetics, medicines, soap,

paint, and any other product that may be controlled by the ONCQ and delivered for domestic consumption and found in commerce, as well as quantifying the level of consumption risk.

-Carry out expert appraisals and analyses as part of the fight against fraud and adulteration.

-Study the causes of deterioration in product quality, and advise economic operators on corrective measures.

2.5. Type and Duration of Study

This is a prospective descriptive, analytical, longitudinal study lasting 4 months from February 4 to May 6, 2019 to determine the bacteriological quality of weaning porridges and purees.

2.6. Sampling

Sampling was random and simple, covering weaning porridges and purées prepared for children aged 6 to 24 months by CREN for dietary diversification. A total of 8 eight samples were taken from sterilized cans and placed in a cooler at a temperature of +4˚C. The resulting sample was taken to the ONCQ laboratory for bacteriological analysis. All porridges and purées prepared at INSE during our study were included.

2.7. Biological Materia

The biological material is of 2 types: rice porridge enriched with peanut paste and plantain purée.

2.8. Study Variables

Our variables were the analysis of bacteriological parameters of weaning porridges and purees: on the enumeration of proliferating flora and contaminating germs according to the methods described in Horizontal enumeration methods in the AFNOR standard.

-Enumeration of total aerobic mesophilic flora (NF 4833, 2003) [22].

-Enumeration of total and fecal coliforms (ISO 4832, 2006) [23].

-Enumeration of sulfite-reducing anaerobes (AFNOR ISO 7937, 2004) [24].

-Salmonella detection (ISO 6579, 2002) [25].

-Enumeration of staphylococci (ISO 68888-1: 2021, 2023) [26].

-Enumeration of fecal streptococci (AFNOR ISO 7937; 2005) [27].

2.9. Microbiological Variables

2.9.1. Proliferation Flora

-Flora Aerobic Mesophilic Total.

-Coliform Total.

2.9.2. Contamination Germs

-Coliform Fecal.

-Anaerobic Sulphite Reducing bacteria.
-Staphylococcus aureus.
-Salmonella.
-Fecal Streptococcus.

2.10. Microbiological Analysis

The microbiological analysis of weaning porridges and purées was based on the search for micro-organisms likely to alter the hygienic and/or nutritional quality of the feed or to contaminate it. These included germs such as Mesophilic Aerobic Flora, Total Coliforms, Faecal Coliforms, Anaerobic Sulphite Reducing 7 bacteria, Staphylococcus aureus and Salmonella. The samples analyzed were taken just after the production of each porridge and purée. Ten grams of each food were taken, to which 90 g of salted peptone water (SPW) was added. The mixture was homogenized for 3 minutes to obtain the stock solution. Each decimal dilution was inoculated in duplicate on specific culture media to count the number of germs retained (NM 08.0.100, 2001). Total mesophilic aerobic flora, total coliforms and fecal coliforms were counted according to the procedures proposed by (NF 4833, 2003). Total mesophilic aerobic germs were counted on PCA (plate count agar) medium after 24 hours of incubation at 37˚C. Yeasts and molds were counted on Sabouraud agar in Petri dishes after incubation for 24 hours at 37˚C. Total and fecal coliforms were counted on VRBG (Violet Red Bile Agar) medium after 24 hours of incubation at 37˚C for total coliforms and 44˚C for fecal coliforms for 48 hours. Enumeration of fecal streptococci was carried out in accordance with the standard (AFNOR ISO 7937; 2005).

Salmonella was enumerated using a stock solution prepared from 25 g of food and 225 ml of peptone water in accordance with the standard (ISO 6579, 2002), which consisted of pre-enrichment in non-selective medium at 37˚C for 24 hours and enrichment in selective medium at 44˚C for 24 hours

Staphylococcus enumeration was carried out in accordance with the standard (ISO 68888-1: 2021). Staphylococcus aureus were counted in Mannitol chapmanagard medium (Sharlaud) after 48 hours of incubation at 37˚C.

2.11. Data Collection and Processing Methods

Our data were collected through survey sheets and laboratory analyses, then entered and processed on Word and Excel 2016 software under Windows and the representation of results by tables and figures.

3. Results and Discussion

In this study, weaning porridges and purées prepared at INSE were analyzed and the results were presented in tables and figures, which were interpreted and discussed according to the available literature. Good hygiene during weaning food preparation improves children's health.

Table 1. Results of microbiological analyses of rice porridge enriched with peanut paste.

Germs	Total	Standards Ufc/g	Samples			
			Compliant		No compliant	
			Quantity	%	Quantity	%
FMAT	10	3.10^5	10	100	-	-
CT	10	10^2	10	100	-	-
CF	10	10	9	90	1	10
SF	10	10	10	100	-	-
ASR	10	30	10	100	-	-
STA	10	10^2	10	100	-	-
SAL	10	Abs/25	10	100	-	-

Legend: FMAT: total aerobic mesophilic flora; CT: total coliforms; CF: faecal coliforms; SF: faecal streptococci; ASR: anaerobic sulphite-reducing bacteria; STA: staphylococci; SAL: salmonella.

Table 1 shows that, of all the germs tested, only faecal coliforms failed to comply with sanitary standards, *i.e.*, 10% of samples, demonstrating the ineffectiveness of hygienic practices during preparation.

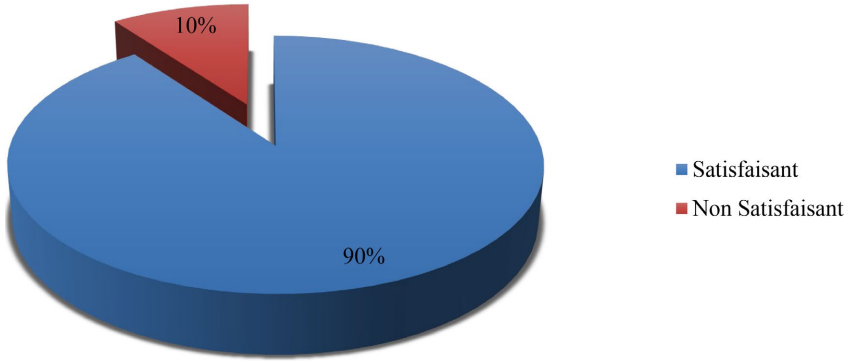

Figure 2. Bacteriological quality of rice porridges enriched with peanut paste.

In Figure 2, we see that 90% of the samples of rice porridge enriched with peanut paste had satisfactory bacteriological quality. These results differ from those reported by Kamardine Abdou in 2019 in Guinea at the Jean-Paul II nursery school) [16] with 70% satisfactory bacteriological quality in all milk porridge samples.

From Table 2, we can see that 100% of the porridge samples were within the required standards, i.e., without spoilage. This can be explained by good hygienic practices during preparation by the caterers and the conditions under which the food was stored. The load of mesophilic aerobic germs varied from 2.2.102 to 9.6.102 CFU/g. Total coliforms range from 10 to 12 CFU/g. Thermotolerant coliforms, Staphylococcus aureus and Salmonella were not detected in porridges and purees. The bacterial loads detected in the porridges and purées were below the

microbiological criteria applicable to infant flours (Codex Alimentarius, 2019).

Table 2. Degree of proliferation of samples of rice porridge enriched with peanut paste

Germes	Quantity of germs/Samples						Quantity	%
	Without		Moderate		Severe			
	Quantity	%	Quantity	%	Quan-tity	%		
FMAT	10	100	-	-	-	-	10	100
CT	10	100	-	-	-	-	10	100

Table 3. Results of microbiological analysis of leftover plantain purée.

Germs	Total	Standarts Ufc/g	Samples			
			Compliant		No compliant	
			Quantity	%	Quantity	%
FMAT	10	3.10^5	10	100	-	-
CT	10	10^2	8	80	2	20
CF	10	10	2	20	8	80
SF	10	10	10	100	-	-
ASR	10	30	10	100	-	-
STA	10	10^2	10	100	-	-
SAL	10	Abs/25	10	100	-	-

In Table 3, we note that only 2 out of 5 parameters (Total Coliforms and Faecal Coliforms) did not comply with sanitary standards, respectively 20% and 80% of contamination in the samples analyzed. On the other hand, we noted the total absence of fecal Streptococci, Anaerobes Sulfitoréducteur, Staphylococci and Salmonella.

Table 4. Degree of proliferation of samples of leftover plantain purée.

Germs	Quantity of germs/Samples						Quantity	%
	Without		Moderate		Severe			
	Quantity	%	Quantity	%	Quantity	%		
FMAT	10	100	-	-	-	-	10	100
CT	-	-	8	80	2	20	10	100

Samples of leftover Plantin banana purée were 100% contaminated with total Coliforms, with 80% moderate and 20% severe contamination. This spoilage can be explained by poor food preservation and/or by the fact that the food was exposed to the open air and to insects (flies), which are mechanical transmitters of germs. (Table 4)

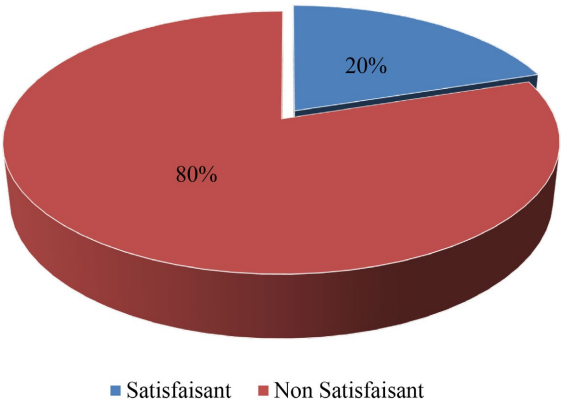

Figure 3. Bacteriological quality of samples of leftover plantain purée.

Figure 3 shows that 80% of the samples of leftover plantain purée were of unsatisfactory bacteriological quality. This can be explained by poor food preservation.

4. Discussion

Among the germs tested, only fecal coliforms failed to meet health standards, representing 10% of samples. These different loads are below the microbiological criteria for mesophilic aerobic germs (105 CFU) in porridges and purees. This result corroborates the work of Grodji and all in Ivory Coast [14], who found the same percentage of faecal coliforms.

The development of a healthy, high-quality supplementary food that complies with international standards requires technical skill and expertise in terms of technological, microbiological and nutritional parameters. Weaning porridges and purées are prepared for children at INSE. In this study, our results show that 90% of the samples of rice porridge enriched with peanut paste were of satisfactory bacteriological quality. These results differ from those reported by Kamardine Abdou in 2019 in Guinea at the Jean-Paul II nursery school with 70% satisfactory bacteriological quality in all milk porridge samples [16].

The load of mesophilic aerobic germs varies from 2.2.102 to 9.6.102 CFU/g. The load of total coliforms varies from 10 to 12 CFU/g, providing sufficient evidence that the preparation of porridges and purées has an effect on these germs. This result corroborates the work of [10], which is below the microbiological criteria applicable to infant flours (Codex Alimentarius, 2019) [16].

Weaning porridges and purées prepared to meet children's nutritional needs. By comparison, the quality of porridges and purées is in line with the quality recommended by the WHO. Moreover, these results clearly demonstrate the undeniable quality of the porridges and purées prepared as part of this study. The 20% 80% Satisfaisant Non Satisfaisant 11 importance of the safety of complementary foods for children is well known. After the age of 6 months, most of the food must come from complementary foods [3]. Given the level of presence of the elements previously mentioned, we can deduce that these weaning porridges and purées

will not be a source of contamination for children [28].

5. Conclusion

A study of the bacteriological quality of weaning porridges and purees prepared at the Nutritional Recovery and Education Centre of the Guinea Institute of Nutrition and Child Health deled to the following conclusion: In this study, we found that the samples of rice porridge with peanut paste and Plantin banana purée were of satisfactory bacteriological quality, at 90% and 60% respectively. We found that Total Aerobic Mesophilic Flora (TAMF), faecal Streptococcus, Staphylococcus and Salmonella complied with health standards for all samples analyzed. On the other hand, we found contamination in samples of leftover rice porridge enriched with peanut paste and Plantin banana purée, with 50% contamination by faecal Coliforms and 40% by Anaerobic Sulphite Reducing bacteria. In terms of spoilage, the samples of rice porridge enriched with peanut paste and Plantin banana purée showed no signs of spoilage, while the samples of leftover rice porridge enriched with peanut paste and leftover Plantin banana purée showed high levels of total coliforms, with 40% contamination of leftover rice porridge enriched with peanut paste and 20% contamination of leftover Plantin banana purée. Finally, the lack of knowledge of hygiene and preservation rules by handlers during the preparation of weaning foods can lead to food contamination. For this reason, hygienic measures must be taken to promote a healthy diet and reduce the risk of foodborne illnesses in children.

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Conflicts of Interest

The authors declare that they have no conflict of interest.

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