# Food supplementation practices and characterisation of some dishes associated with the diet of children aged 6 to 36 months in the rural area of Man (Ivory Coast)

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**Summary**

Inappropriate practices of feeding young children are a factor in malnutrition. This study aims to provide in-depth knowledge of infant feeding practices in the Man region in order to create a database and develop well-targeted strategies to reduce the prevalence of child malnutrition. A descriptive cross-sectional survey of 240 women was conducted to assess their knowledge and practices regarding the feeding of young children. The sampling frame for the study covered eight rural localities in Man, namely Kassiapleu, Petit Gbępleu, Gbangbégouiné-Yati, Kouitongouiné 1, Kouitongouiné 2, Gbouakpalé, Zélé and Guianlé. The majority of women (75.4 %) started feeding supplements between 6 and 12 months. Only 49.5 % of them received medical support. They also felt that the ideal age to stop breastfeeding was between 12 and 24 months. The most commonly used foods for supplementation were cereal porridge (88.5 %), dried cassava flour paste kokondé (45.4 %) and fermented cassava flour paste placali (36.3 %). Inappropriate supplementation practices were observed in about half of the children studied.

**Keywords**

complementary foods; feeding practices; children aged 6 to 36 months; Ivory Coast

During the first six months of a child's life, breast milk perfectly meets all the child's nutritional needs. The World Health Organisation (WHO) and United Nations of International Children's Emergency Fund (UNICEF) Global Strategy on Infant and Young Child Feeding therefore recommends exclusive breastfeeding for up to 6 months [1]. This would prevent the deaths of approximately 1.3 million children under the age of 5 each year, which is a major problem in developing countries [2]. However, after 6 months of age, breast milk becomes insufficient in quality and quantity for infants, whose nutritional needs increase [3].

Feeding practices are key determinants of children's nutritional status, which, in turn, influences their morbidity and mortality. Among feeding practices, breastfeeding and the introduction of complementary foods are particularly important during the first two years of life [4]. Therefore, the diet must be progressively diversified to help the infant make the transition from an exclusively milk-based diet to an adult diet [5]. The complementary feeding period is, therefore, a period of high risk of deficiency. In many developing countries, malnutrition and mortality of infants and young children are closely linked to frequently inappropriate complementary feeding practices [6]. Given the importance of the quality of complementary feeding during this period, recommendations have been made based on the nutritional requirements of children at the age of introduction and for the development of nutritionally and healthily adequate infant formulae [7].

In Ivory Coast, research into the socio-an-

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thropological bases of malnutrition shows that 'inappropriate' feeding practices by mothers in the north-west of the country are at the root of malnutrition among children aged 0–5 years. In fact, people in these areas believe that certain local preparations in the form of maize porridge have nutritional and therapeutic qualities, on the pretext that they make children overweight [8]. In the regions of Ivory Coast, mothers' feeding practices are shaped by a system of thought characterised by ignorance, family beliefs, received ideas and other socio-cultural factors [8].

The aim of this study was to identify maternal socio-demographic factors associated with complementary feeding practices among children aged 6–36 months in rural Man.

## MATERIAL AND METHODS

### Fields of study

Man is a city with an area of 2.893 km$^2$, located in the west part of Ivory Coast, 563.2 km from Abidjan, and it is the capital of the Tonkpi region. It lies at 7°24'32'' north latitude and 7°33'24'' west longitude. The population of Man is estimated at 461 135, including 245 091 male and 216 044 female [9].

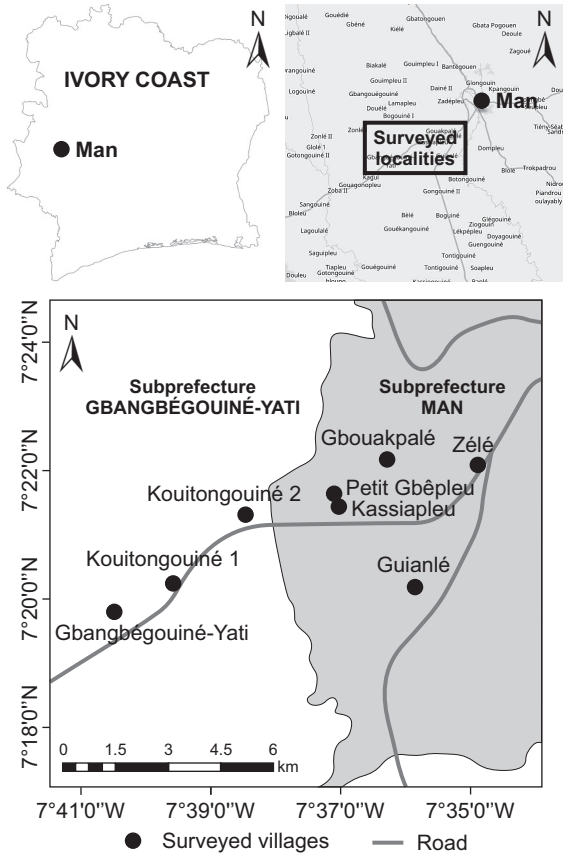


**Fig. 1.** City Man on the map and location of surveyed villages.

### Survey sites

The study was carried out in 8 rural communities in the district of Man, namely the villages of Kassiapleu, Petit Gbępleu, Gbangbégouiné-Yati, Kouitongouiné 1, Kouitongouiné 2, Gbouakpalé, Zélé and Guianlé (Fig. 1).

### Survey on infant feeding practices

### Selection of respondents

The women were selected using a technique called snowball sampling. This is a non-probabilistic sampling method, in which a respondent is selected at random and a list of other respondents is gradually compiled from the net of the acquaintances. A total of 240 women were interviewed, i.e., 30 women per village. The inclusion criteria were as follows:

- women living in the village at the time of the survey,
- women with children aged 0–36 months and knowledge of infant feeding practices,
- women with children over 36 months and knowledge of child feeding practices.

The formula used for the sample size is that of Schwartz [10]:

$$N = \frac{t^2 p(1-p)}{m^2} = \\ = \frac{1.96^2 \cdot 0.95 \cdot (1-0.95)}{0.05^2} = 73 \quad (1)$$

where $N$ is the minimum sample size, $t$ is confidence level ($t$ = 1.96), $m$ is margin of error ($m$ = 5 %) and $p$ is probability of achievement ($p$ = 95 %).

### Conducting the survey

This study is a descriptive cross-sectional survey of 240 women, using a questionnaire prepared with SPHINX Plus software V5.1.0.6 (Le Sphinx Développement, Chavanod, France). The sampling frame consisted of 8 villages mentioned above, all located at the outskirts of the University of Man. Data collection took place over a period of approximately one month, from 1 February 2023 to 28 February 2023, and allowed for the collection of information on socio-demographic characteristics, as well as on mothers' nutritional practices and knowledge regarding the nutrition of their children.

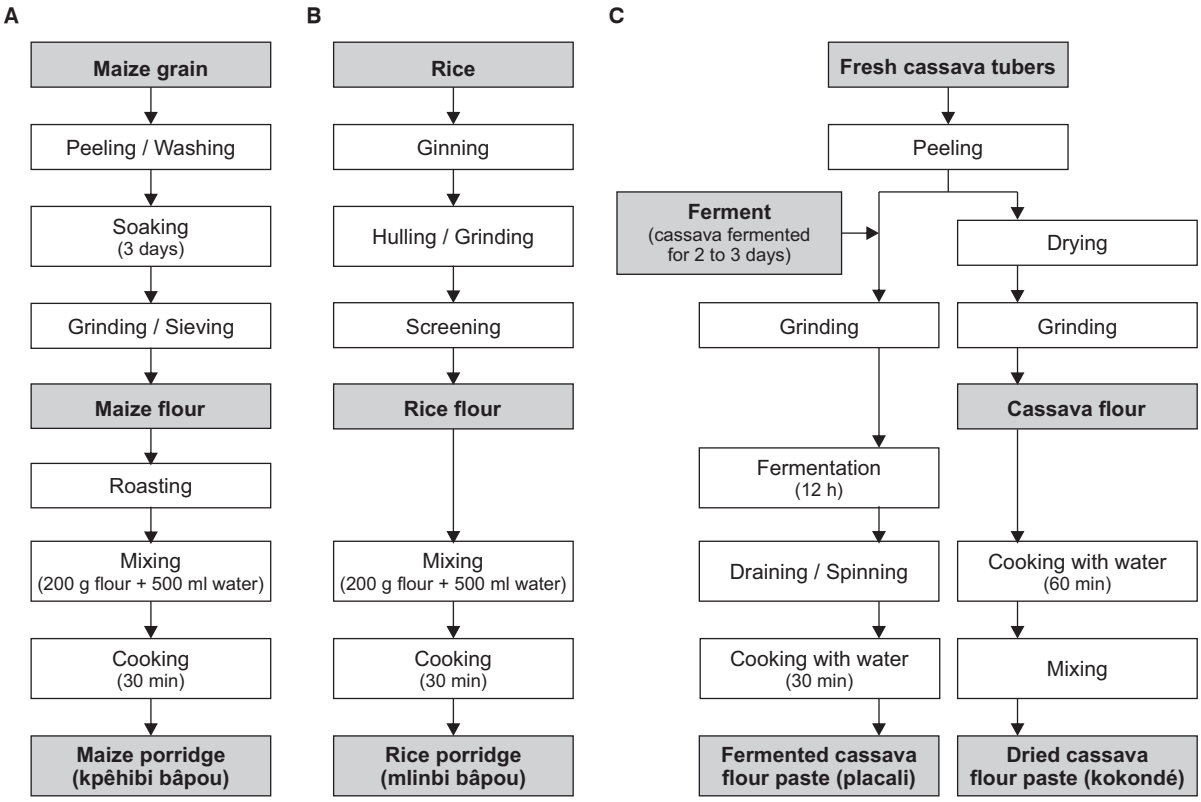


**Fig. 2.** Preparation of traditional dishes.

A – maize porridge, B – rice porridge, C – fermented and dried cassava flour paste.

**Preparation of traditional dishes**

The plant material used after the survey consisted of:

- maize (*Zea mays*) and rice (*Oriza sativa*) seeds for the preparation of maize porridge (kpęhibi bâpou) and rice porridge (mlinbi bâpou) respectively;
- cassava tuber (*Manihot esculenta*) for the preparation of fermented cassava flour paste (placali) and dried cassava flour paste (tô, kokondé).

**Maize porridge (kpęhibi bâpou)**

The flour used to make kpęhibi bâpou was obtained by grinding and sifting maize grains. This flour was then toasted over low heat and cooked in water to the desired consistency (Fig. 2A).

**Rice porridge (mlinbi bâpou)**

The flour used to make mlinbi bâpou was obtained after the rice grains had been husked and sifted. This rice flour was then mixed with boiling water and further cooked in water (Fig. 2B).

**Fermented cassava flour paste (placali)**

The process of preparing placali is shown in Fig. 2C. The cassava tubers were peeled and washed. Subsequently, a fermenting agent obtained from fresh cassava stored in jute bags for two to three days was added. The mixture was then ground. The resulting paste was left to ferment for 12 h, then drained and wrung out. The drained paste was then diluted with water and the mixture was filtered in a metal pot. After 5 min, the filtrate contained in the pot was placed on the stove and the mixture was stirred with a spatula until a light mush was obtained, which reached a homogeneous consistency after 10 min. After another 10 min, the cooked filtrate takes the form of a gelatinous mass and the placali is finally served, packaged and preserved.

**Dried cassava flour paste (tôh, kokondé)**

Tôh of cassava, known locally as kokondé, is a dish made from cassava flour (Fig. 2C). The cassava pods were washed, dried and ground to obtain the flour. 4/5 of the water was heated to boiling. While it was boiling, 2/5 of the boiling water was removed from the pot and stored in a container. The sieved cassava flour is gradually added to the boiling water, stirring with a spatula until a light porridge with an even consistency is

obtained. After 10 min of cooking, 1/5 of the water is added to the light porridge and the mixture is vigorously stirred for around 15 min until it thickens.

### Supplementation of the dishes

To achieve the composition of the dishes as traditionally served, the maize and rice porridge were supplemented with a source of fat. For the cassava flour pastes, placali and kokondé, the local sauce containing mushrooms and frog meat was supplied by a woman participating in the survey.

### Determination of biochemical compounds

The various analyses carried out concerned dry matter (AOAC 925.10), ash (AOAC 942.05), total lipids (AOAC 963.15) [11], total carbohydrates [12], proteins [13] and energy [14].

### Statistical analysis

Two types of statistical analysis were used for data processing. These are ANOVA variance analysis and Duncan's test for averaging. Both of these analyses are done by the SPSS 20.0 (IBM, Armonk, New York, USA). The meaning is accepted at a level of 5 % ($P \leq 0.05$).

**Tab. 1.** Socio-demographic characteristics of mothers surveyed in rural areas of Man.

| Characteristic | Respondents | |
|---|---|---|
| | Number | [%] |
| **Marital status** | | |
| Single | 50 | 20.7 |
| Married | 178 | 74.2 |
| Widowed | 12 | 5.0 |
| **Age** | | |
| 15–30 years | 109 | 45.4 |
| 30–45 years | 111 | 46.3 |
| > 45 years | 20 | 8.3 |
| **Level of study** | | |
| No instruction | 148 | 61.7 |
| Primary | 70 | 29.2 |
| Secondary | 22 | 9.2 |
| **Profession** | | |
| Housekeeper | 160 | 66.7 |
| Shopkeeper | 57 | 23.8 |
| Artisan | 20 | 8.3 |
| Civil servant | 3 | 1.3 |

Number of respondents ($n$ = 240).

**Tab. 2.** Distribution of women according to their source of information on food supplements in rural areas of Man.

| Source of information | Respondents | |
|---|---|---|
| | Number | [%] |
| None | 118 | 49.2 |
| Mother | 19 | 7.9 |
| Mother-in-law | 9 | 3.8 |
| Husband | 3 | 1.3 |
| Health worker | 90 | 37.5 |

Number of respondents ($n$ = 240).

## RESULTS

### Socio-demographic characteristics of women

The socio-demographic characteristics of the women are shown in Tab. 1. Most respondents were between 15 and 45 years old, 45.7 % were married and 61.7 % had not attended school. Overall, 66.7 % of the women were housekeepers.

### Time and reason of supplementation

The results of the survey showed that the majority of women (75.4 %) started supplementation at 6 months of age. However, over 21 % started before 6 months of age (Fig. 3A). 84.6 % of the women felt that their infant was ready to receive foods other than breast milk (Fig. 3B). In most cases (49.2 %) they did not receive any advice from a person experienced in supplement introduction, although some (37.5 %) received information from health professionals (Tab. 2).

After the first supplementation, the majority of women (61.2 %) reported that they no longer varied their infant's diet, while 38.8 % of them provided other types of food (Fig. 3C). The majority of women (63.9 %) varied their baby's diet at age from 12 months onwards, compared with 31.1 % between age 6 and 12 months, as shown in Fig. 3D.

### Identification of food supplements

Tab. 3 shows the food supplements used in the diets of children aged 0–36 months. About ten (10) traditional foods used in children's diets were identified. In general, whatever the age group, the main foods are cereal porridge (87.5 %), kokondé (45.4 %), placali (36.3 %) and manufactured infant cereals (34.2 %).

### Weaning practices for infants

The survey found that 75.4 % of mothers weaned their children between the ages of 6 and

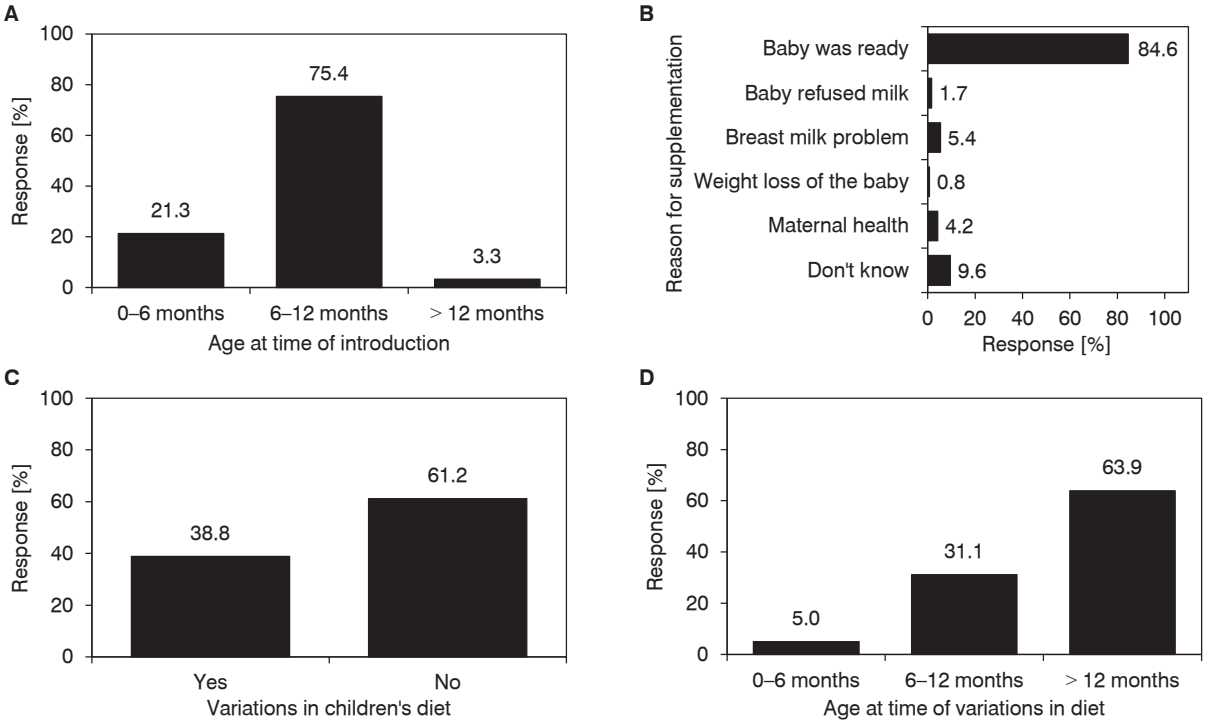


**Fig. 3.** Time and reason of supplementation in children's diet.

A – age at time of introduction of local foods into the diet, B – reason for supplementation, C – variations in children's diet after first supplementation, D – age at time of variations in children's diet.

12 months (Fig. 3A). Mothers who were asked about weaning gave two main reasons: "It was the ideal time" (69.6 %) and "The baby refused the milk" (22.5 %) (Tab. 4). The most common food used during weaning was rice (97.9 %), followed by cassava-based dishes such as placali (71.7 %), kokondé (44.2 %) and foutou (36.7 %) (Tab. 5).

**Physicochemical parameters of local dishes**

The physicochemical composition of local dishes is shown in Tab. 6.

The ash content for the maize and rice slurries was very low. The ash content for placali is lower than for kokondé. Although placali has the lowest ash content, it has the highest dry matter content.

**Tab. 3.** Food supplements in the diet of children aged 0–36 months in rural areas of Man.

| Dishes | Age of children | | | | | |
|---|---|---|---|---|---|---|
| | 0-6 months | | 6-12 months | | > 12 months | |
| | Number | [%] | Number | [%] | Number | [%] |
| Maize porridge (kpẹhibi bâpou) | 37 | 15.4 | 120 | 50.0 | 3 | 1.3 |
| Rice porridge (mlinbi bâpou) | 12 | 5.0 | 38 | 15.8 | | |
| Millet porridge | | | 8 | 3.3 | | |
| Manufactured infant cereals | 15 | 6.3 | 67 | 27.9 | | |
| Mashed potatoes (potato and potato) | | | 20 | 7.5 | | |
| Dried cassava flour paste (kokondé) | 12 | 5.0 | 29 | 20.0 | 49 | 20.4 |
| Fermented cassava flour paste (placali) | 3 | 1.3 | 31 | 12.9 | 53 | 22.1 |
| Fresh cassava flour paste (foutou) | 3 | 1.3 | 13 | 5.4 | 14 | 5.8 |
| Wheat pasta (vermicelli) | 8 | 3.3 | 48 | 20.0 | 6 | 2.5 |
| Boiled yam | | | 3 | 1.3 | | |
| Cassava couscous (attieke) | | | 5 | 2.1 | 3 | 1.3 |
| Rice | 17 | 8.3 | 44 | 37.1 | 124 | 51.7 |

Number of respondents ($n$ = 240).

**Tab. 4.** Distribution of mothers by reason for weaning their child in rural areas of Man.

| Reason for weaning | Respondents | |
|---|---|---|
| | Number | [%] |
| Baby refuses milk | 54 | 22.5 |
| Mother's unavailability | 12 | 5.0 |
| Advice from the husband | 10 | 4.2 |
| The perfect time | 167 | 69.6 |
| Don't know | 7 | 2.9 |

Number of respondents ($n$ = 240).

**Tab. 5.** Distribution of food for weaning children in rural areas of Man.

| Dishes | Respondents | |
|---|---|---|
| | Number | [%] |
| Dried cassava flour paste (kokondé) | 106 | 44.2 |
| Fermented cassava flour paste (placali) | 172 | 71.7 |
| Fresh cassava flour paste (foutou) | 88 | 36.7 |
| Fresh banana flour paste (foutou) | 21 | 8.8 |
| Fresh yam flour paste (foutou) | 8 | 3.3 |
| Wheat pasta (vermicelli) | 25 | 10.4 |
| Cassava couscous (attieke) | 19 | 7.9 |
| Rice | 235 | 97.9 |

Number of respondents ($n$ = 240).

**Tab. 6.** Physicochemical and nutritional composition of local dishes used in the diets of children in rural areas of Man.

| | Local dishes | | | |
|---|---|---|---|---|
| | Maize porridge (kpẹhibi bâpou) | Rice porridge (mlinbi bâpou) | Fermented cassava flour paste (placali) | Dried cassava flour paste (kokondé) |
| pH | 5.5 ± 0.2 [a] | 6.7 ± 0.3 [a] | 4.4 ± 0.1 [a] | 5.3 ± 0.1 [a] |
| Dry matter [g·kg$^{-1}$] | 171.1 ± 6.2 [a] | 145.5 ± 5.1 [a] | 204.2 ± 2.9 [a] | 191.8 ± 1.4 [a] |
| Ash [g·kg$^{-1}$] | 1.0 ± 0.3 [a] | 2.0 ± 2.0 [a] | 79.0 ± 2.4 [b] | 88.4 ± 2.1 [b] |
| Carbohydrates [g·kg$^{-1}$] | 854.0 ± 5.6 [a] | 814.0 ± 5.4 [a] | 616.0 ± 7.2 [b] | 603.0 ± 2.5 [b] |
| Protein [g·kg$^{-1}$] | 88.0 ± 3.8 [a] | 128.0 ± 5.0 [a] | 257.0 ± 5.7 [b] | 276.0 ± 2.3 [b] |
| Lipid [g·kg$^{-1}$] | 62.0 ± 2.6 [a] | 54.0 ± 4.0 [a] | 48.0 ± 3.3 [a] | 40.0 ± 0.9 [a] |
| Energy value [MJ·kg$^{-1}$] | 18.1 ± 0.1 [a] | 17.8 ± 0.2 [a] | 16.4 ± 0.2 [b] | 16.2 ± 0.1 [b] |

Maize and rice porridges were supplemented with a source of fat. Cassava flour paste was supplemented with a sauce containing meat and mushrooms.
Values are based on dry matter except values of pH and dry matter, which are based on wet food. Means followed by the same letter in the same row are not significantly different at $P$ = 0.05.

### Nutritional parameters of local dishes

The macronutrient contents and energy values of the local dishes are given in Tab. 6. The data show that maize and rice porridge have high carbohydrate contents. The protein content of rice porridge was higher that of maize porridge, but the difference was not statistically significant. The difference in lipids' content also did not pass the statistical significance level. Together, these macroelements give these two dishes very high and almost identical energy values.

The data show that fermented and dried cassava flour paste are rich in carbohydrates. In terms of protein, kokondé was richer than placali. For lipids, placali had a higher relative content compared to kokondé. Together, these macroelements give these two dishes very high energy values. Placali has an energy value almost identical to kokondé.

## DISCUSSION

The survey of infant feeding practices in rural Man revealed a number of findings that highlight the importance of promoting local dishes to improve the management of infant malnutrition in this region. From a socio-demographic point of view, the survey showed that 74.2 % of women are married and 66.7 % are housewives, with a high illiteracy rate (61.7 %). These results are in line with those of Diallo [15], who found that 97 % of the women were married and 61 % had not attended school in her study on mothers' knowledge, attitudes and practices regarding the feeding of children aged 0–23 months and their nutritional status. The same is true for the study by Diawara [16], who found that 96.2 % of mothers were married, 92.9 % were housewives and 65.3 % had not attended school. The high rate of women

not attending school could be the result of several factors that reflect the rural reality, where women generally have few opportunities, under the influence of certain cultural practices.

With regard to the rate of supplementation of infant food, the age of introduction of food was estimated at 75.4 % between 6 and 12 months. Among the reasons given, 84.6 % of mothers felt that the baby was ready. These findings are consistent with those of GUEYE [17], who found that the age range was 6 months and above in 55.8 % of cases. In addition, MAVUTA et al. [18] found that 92.4 % of women reported introducing complementary foods into their child's diet from the age of 6 months. Our findings are in line with the WHO standards [1], which recommend that complementary foods should only be introduced into young children's diets from the age of 6 months.

In addition, the women surveyed did not receive any advice (49.5 %) or professional support (62.5 %) in managing infant feeding. This finding contrasts with that of TRAORE et al. [19], who found that 61.8 % of mothers had received advice from a health worker. This may reflect adherence to customary practices, which often contradict WHO recommendations, and a lack of information on appropriate feeding practices in early childhood. This information could be provided by a health worker, whose role is to explain how to introduce the first foods other than breast milk and to teach certain behaviours for the best development of the child.

In general, regardless of age group, the most commonly eaten dishes were cereal porridge (88.5 %), kokondé (45.4 %), placali (36.3 %) and manufactured infant cereals (34.2 %). Our results could be explained by the fact that cereals are generally grown as staple crops in almost all regions of Ivory Coast. This is in line with the recommendations of the WHO [1], which advocates the introduction of semi-solid foods from 6 months of age as a good feeding practice. In fact, the early introduction of foods (before 6 months) encourages the competition with breast milk [20] at a time when the baby's physiology does not allow him to take full advantage of these foods and their consumption.

Regarding the age of weaning, the majority of mothers (75.4 %) thought that the ideal time for weaning was between 12 and 24 months. The current consensus is that all children should be breastfed from birth and for as long as possible, at least for the first two years of life. For this reason, WHO [1] recommends that children should be exclusively breastfed until 6 months of age and continued until 2 years of age. Breastfeeding beyond 6 months is extremely important because it provides the child with micronutrients, vitamins and polyunsaturated fatty acids, which are found in lower concentrations in cereal-based infant formulae [21]. In addition, 38.8 % of mothers changed the foods they fed their children from the age of 12 months by introducing solid foods (family dishes) such as rice, placali, cassava foutou and tôh. These results differ from those of DIADIE [22] regarding the rural areas in Niger, where the introduction of family dishes was observed mainly among certain ethnic groups (Haoussa) before 6 months (53.2 %) and 7 months (35.3 %), respectively.

The low dry matter content of the porridges does not meet the WHO's recommended standard of 300 $g \cdot kg^{-1}$ dry matter in infant porridges [1]. However, our values are higher than those (78 $g \cdot kg^{-1}$ and 104 $g \cdot kg^{-1}$) obtained by HASSAN [23] for fermented millet porridges in Burkina Faso. Indeed, the lower the dry matter content, the more fluid the porridge and the less energetically dense it becomes. Consequently, such porridges can lead to protein-energy deficiencies, potentially resulting in weight loss [24].

Regarding the nutritional value of these porridges, the carbohydrate content of either maize porridge or rice porridge exceeds the WHO recommendation of 68 % for infants aged 6 to 12 months in porridges [1]. Our results are similar to those of CAROLE et al. [25], who found a carbohydrate content of 801.4 $g \cdot kg^{-1}$ for millet porridge, 850.8 $g \cdot kg^{-1}$ for kokobaka porridge, and 795 $g \cdot kg^{-1}$ for anagobaka porridge. This could be justified by the fact that rice and maize are starch-rich foods, but also by the large daily production quantities of porridge. This high carbohydrate content could lead to obesity, digestive disorders, pain or constipation in the child.

The protein and lipid contents of these porridges are lower than the WHO recommendations of 150 $g \cdot kg^{-1}$ protein and 8 % lipids in infant nutrition [1]. Our results differ from those of AMOIN [24], who found protein contents ranging from 135 $g \cdot kg^{-1}$ to 158 $g \cdot kg^{-1}$ in porridges prepared from a mixture of sprouted maize and sorghum. The protein deficiency in the porridges could inhibit the child's growth. Additionally, lipids play an important role in satiety and weight gain. A food low in lipids and energy promotes weight loss.

The carbohydrate contents for kokondé and placali are similar to those of ZANNOU-TCHOKO et al. [26], who obtained carbohydrate contents ranging from 610 $g \cdot kg^{-1}$ to 630 $g \cdot kg^{-1}$ in mixed weaning flours containing cassava, soy and

sprouted maize component. Since placali and kokondé are complementary foods, their carbohydrate contents meet this standard. Carbohydrates play an essentially energetic role and provide the body with the necessary energy to function. As for lipids, these different foods have relatively low contents. The values are higher than those of YÉBOUÉ et al. [27], who observed lipid contents of 0.9 % for placali. This lipid deficiency could lead to weight loss in children [28].

The protein contents differ from those observed by YÉBOUÉ et al. [27], who found protein contents of 10.9 $g \cdot kg^{-1}$ (placali) and 15.3 $g \cdot kg^{-1}$ (attieke). Thus, according to DIALLO et al. [29], cassava is a protein-poor food. Therefore, the protein contents observed in our study apparently result from the use of frogs and mushrooms, protein-rich foods according to BARROS et al. [30]. These food materials, frequently consumed by the populations of Man, have been introduced into various accompanying sauces. These animal and plant resources could be used to address protein-energy nutritional deficiencies in children.

The energy values of cereal porridges are slightly higher than those of kokondé and placali. The results are similar to those of ZANNOU-TCHOKO et al. [26], who observed values ranging from 16.31 $MJ \cdot kg^{-1}$ to 16.48 $MJ \cdot kg^{-1}$ in mixed weaning flours containing cassava, soy and sprouted maize components. However, our results are lower than values of the WHO, which recommends a total energy intake between 23.01 $MJ \cdot kg^{-1}$ and 50.20 $MJ \cdot kg^{-1}$ for children aged 6 to 36 months.

## CONCLUSION

This study provides important data on dietary diversification in children aged 6 to 36 months in rural areas of Man, with an intention to enhance the value of local foods. Supplementation practices were inappropriate in about half of the children studied. The age at which foods were introduced was estimated to be between 6 and 12 months, and the most commonly consumed foods were cereal-based porridges. Strategies aimed at improving maternal dietary behaviour are, therefore, needed to improve the nutrition of children in rural areas of Man.

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