



## Both encouraging feeding style and high energy density may increase energy intakes from fermented millet gruels eaten by infants and toddlers in Ouagadougou



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### ARTICLE INFO

#### Article history:

Received 7 January 2015  
Received in revised form  
11 January 2016  
Accepted 15 January 2016  
Available online 19 January 2016

#### Keywords:

Complementary feeding  
Energy density  
Feeding style  
Food intake  
Cereal-based fermented food

### ABSTRACT

Traditional fermented millet gruel is frequently eaten by children in Burkina Faso as a complementary food or for breakfast. The effects of gruel energy density and feeding style on intakes (amounts and energy) were assessed in children in Ouagadougou. Twenty-three young children (11 infants and 12 toddlers) were given two meals of gruel per day for two periods of 11 consecutive days, first, the traditional fermented gruel (TFG), and second, an improved high energy density fermented gruel (IFG). On the first 10 days of each period, the children were fed as usual, while on the 11th day, the mothers were asked to use encouraging feeding. Intakes of TFG and IFG were also measured once a day for nine days in 25 preschoolers (2–5 years-old). After adjustment for the subject effect, IFG intakes did not significantly differ from TFG intakes in the groups of infants and toddlers, meaning there was a significant increase in energy intakes, which almost doubled. Encouraging feeding increased TFG intakes in both age groups, but IFG intakes only increased in toddlers, whose energy intake tripled compared to that from TFG with the usual feeding style. In preschoolers, mean IFG intakes were lower than TFG intakes and there were no increase in mean energy intakes. Improving fermented gruel and training the mothers to encourage their young children during feeding are two possible strategies to improve food intakes, and hence to better satisfy the children's nutritional needs.

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### 1. Introduction

According to WHO recommendations, from six months old, intakes of breast milk are no longer sufficient to cover young children's nutrient needs and other foods should thus be introduced (WHO, 2001). As they are consumed as a complement to breast milk, these foods are called complementary foods and can be of different kinds. In many countries of the Global South, the most frequent complementary foods are cereal-based gruels, particularly for infants aged 6–12 months. In Africa, these gruels are prepared by mixing flour and water and a range of other ingredients. They may or may not undergo lactic acid fermentation, and are then

cooked by boiling (Blandino, Al-Aseeri, Pandiella, Cantero, & Webb, 2003; Guyot, 2010). In Burkina Faso, fermented pearl millet [*Pennisetum glaucum*] gruels are widely eaten by people of all ages and are also frequently used as complementary food. Forty-five percent of the 6–23 month-old children in Ouagadougou eat them daily, but their nutritional value does not fill the gap between nutrient intakes from breast milk and recommended nutrient intakes (Mouquet-Rivier et al., 2008). Research conducted as part of the European CEREFER project (2002) led to changes in processing, which improved the macronutrient balance thanks to co-fermentation of millet with groundnuts, and increased the energy density through partial starch hydrolysis thanks to the addition of malt (Tou et al., 2007). Adding malt makes it possible to increase the concentration of the gruel while keeping the right consistency. Compared to other ways of increasing energy density such as adding oil or sugar, adding malt has the advantage of simultaneously increasing the concentration of all the nutrients in the gruel in the same proportions. So any increase in energy intake

Abbreviations: BW, body weight; IFG, improved fermented gruel; LAZ, Length-for-age Z-score; TFG, traditional fermented gruel; WLZ, weight-for-length Z-score.

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implies a similar increase in the intake of all the nutrients present in the gruel. All these changes obviously have significant effects on the organoleptic properties of the gruel. Sensory tests with mothers showed that the improved gruel was acceptable (unpublished data), but it was still necessary to (i) check its acceptability in real conditions, i.e. when eaten by children during a normal meal and (ii) compare the energy intake from the improved gruel with that of traditional gruel.

Improving the nutritional properties of the gruel is not the only way to improve nutrient and energy intakes from complementary foods. It is widely acknowledged that feeding style also plays an important role (Pelto, Levitt, & Thairu, 2003). Indeed, it has been shown that active feeding can compensate for lack of interest in food (Engle & Zeitlin, 1996). However, in many contexts, the “*laissez-faire*” style of feeding, with rare encouragement to eat, predominates (Bentley, Caulfield, Torun, Schroeder, & Hurtado, 1992). In the guidelines for complementary feeding of breastfed children (PAHO, 2003), the practice of responsive feeding, in which the mother -or caregiver- interacts with the child during feeding, is strongly recommended. But studies which quantify the potential effect of encouragement during feeding on intakes are scarce (PAHO, 2003; Bentley, Wasser, & Creed-Kanashiro, 2011). Previous studies which measured food intakes in young children in Bangladesh (Islam et al., 2008), in Viet Nam (Van Hoan, Mouquet-Rivier, Eymard-Duvernay, & Trèche, 2010) and in Burkina Faso (Traoré, Vieu, Alfred, & Serge, 2005; Cames et al. 2011) reported mean food intakes in the range of 5–20 g/kg of body weight (BW)/meal, i.e. far below the assumed functional gastric capacity of 30 g/kg BW/meal, which is the value most frequently used to establish recommendations for complementary feeding (WHO, 1998). This suggests that in these contexts, the feeding style may not be optimal, i.e. may not favour maximum intakes. The present study was conducted in the framework of the Nutrifaso Programme, which has been underway since 2005 and whose objective is to sustainably prevent the appearance of malnutrition among vulnerable populations through education on good dietary and hygiene habits and health care as well as the provision of locally-produced suitable foods. In this study, two feeding styles were tested to increase the chances of the improved fermented millet gruel having a positive effect on young children's intakes: the mother's usual feeding style, and a style we call “encouraging feeding”, which consisted in continuing to offer the gruel to the child twice after the mother decided to end the meal. To this end, a trial was held to determine the effects of both the type of fermented gruel (traditional vs. improved) and the feeding style (usual vs. encouraging) on food and energy intakes in infants and toddlers who regularly consume traditional fermented gruels in Ouagadougou. In addition, the energy intakes and acceptability of the improved fermented gruel were also assessed in preschool children as they are regular consumers of the traditional fermented millet gruel.

## 2. Subjects, material and methods

### 2.1. Recruitment of participants

The study was carried out in 2006, in Ouagadougou, Burkina Faso. The three following age groups were chosen for recruitment: 6–9 month-old infants ( $n = 12$ ), 15–20 month-old toddlers ( $n = 12$ ), and 2–5 year-old preschoolers ( $n = 25$ ). The sample size was calculated after preliminary measurements of intakes conducted in 6–23 month-old children in Ouagadougou (unpublished data), which gave a mean energy intake of around 60 kcal/meal, with a within-subject variation of 50%. The sample size was calculated with a risk  $\alpha = 0.05$  and a power of 90% using Statgraphics 5.0

software. In these conditions, the sample size required to detect a 50% increase (unilateral test) in mean energy intakes was 11 subjects. As this was an exploratory study, we were looking for a substantial increase in energy intake per meal of up to 50%, which could have a short-term effect on the satisfaction of infants and toddlers' energy needs. Also, we noticed that a sample size of 10 children of only one age group was used in the study by Islam, Pearson, Ahmed, Dewey, and Brown (2006). For these reasons, 12 subjects were finally recruited in the infant and toddler's groups. Concerning the preschoolers, as the study design was different due to the different way such fermented porridges are consumed, a convenient sample size of 25 children was adopted.

Children belonging to one of the three age groups on the first day of the planned study period and who regularly ate fermented millet gruels were selected. The children were recruited on a voluntary basis among the customers of a small production unit which sold fermented millet gruel located in Paspanga, a district of Ouagadougou. The owner of the production unit agreed to learn the modified way of preparing the improved fermented gruel for the purpose of this study.

All the children were weighed and measured in triplicate using calibrated equipment and standardized procedures (WHO, 2004), with the children wearing light clothing and no shoes. Children under the age of two were weighed in the arms of their mother/caregiver using a taring scale or standing alone when they were 2 years-old or older.

One child in the 6–9-month-old group did not complete the study because he and his mother had to leave the area and his data were excluded from data analysis.

Aside from belonging to one of the age groups, to be eligible, the children had to have no apparent handicap, and weight-for-length (WLZ) and length-for-age Z-scores (LAZ) greater than  $-3$ . In the 6–9 and the 15–20 month age groups, they had to be still breastfed but to have started to eat gruel. The parents of each child were visited at home to explain the purpose and the practical details of the study and to obtain their informed consent. The protocol was submitted to and approved by Paspanga Health District and the closest Health Centre to the study area.

### 2.2. Study design

All the children were fed both types of gruel, i.e. the traditional fermented millet gruel (TFG) and the improved fermented millet gruel (IFG), alternately.

#### 2.2.1. Infants and toddlers

Children in the 6–9-month-old and in the 15–20-month-old group were fed the gruel twice a day at home for 11 consecutive days: starting with the TFG, followed by the IFG.

Intakes were measured by field workers on the 1st, 4th, 8th and 11th day during the morning and evening meal. The children were then fed the IFG in the same way for a second period of 11 days. The day before each intake was measured, an appointment was made and the mother was asked not to feed her child during the hour preceding the appointment. Gruel intake per meal was determined by weighing the child's bowl before and after eating, including possible losses. For this purpose, portable electronic scales (range 3 kg and accuracy 0.1 g; Kern & Sohn GmbH, Germany) were used. Total feeding time, i.e., from the beginning to the end of gruel consumption by the child, was recorded using a chronometer.

During observations on the 1st, 4th and 8th days, the field worker was asked not to interfere but to let the mother (or other caregiver) feed the child as usual. On the 11th day, “encouraging feeding” was applied, i.e., the field worker let the mother feed her child as usual, and then, when the mother considered her child had

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