Appetite 53 (2009) 233–240

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Effect of the consumption of high energy dense and fortified gruels on energy and nutrient intakes of 6–10-month-old Vietnamese infants

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ARTICLE INFO

Article history:
Received 5 February 2009
Received in revised form 30 June 2009
Accepted 1 July 2009

Keywords:
Instant flour
Food complement
Fortification
α-Amylase
Energy density
Energy intake
Breastfeeding frequency
Viet Nam

ABSTRACT

The aim of this study was to test the ability of two new products, an instant infant flour and a food supplement containing amylases, to increase energy and micronutrient intakes of infants older than 6 months. Three groups of 48 infants were randomly constituted. Infants in groups 1 and 2 consumed at least twice a day gruel made either from the instant flour or from the food supplement. Infants from the control group received complementary foods prepared in the usual way. Each infant was surveyed during a whole day in order to measure feeding frequencies and characteristics as well as amounts of the different types of complementary foods consumed. Foods consumed by infants in the two experimental groups differed considerably in energy, micronutrient density and in consistency from the home-made complementary foods. Due to the incorporation of amylases, gruels made from the food supplement had a higher energy density, a more appropriate consistency and resulted in higher intakes per meal than gruels made from instant flour. In comparison with home-made complementary foods, both experimental products resulted in significantly higher energy and nutrient intakes. The two experimental products appeared to increase sufficiently both energy and nutrient intakes of infants to complement their breastmilk intake.

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Introduction

Undernutrition and micro-nutrient deficiencies are considered as very serious health problems in many developing countries including Vietnam. This is due to their high prevalence, severity and consequences for mortality and morbidity of infants and young children, particularly in poor rural settings. One of their main causes is the low energy and nutrient densities of home-made gruels used as complementary foods (CFs) (Owino et al., 2007). These gruels are generally prepared from rice flour or a mixture of rice and leguminous flours cooked simply in water. Once gelatinization temperature is reached, the starch swells and gruel viscosity increases (Trèche & Mbomé, 1999). Because of the large quantity of water needed to prepare gruels at a spoonable consistency, the amount of flour is too small to allow infants and young children to meet their energy requirements (WHO, 1998). In addition, cereal-based gruels are often characterized by a low density and bioavailability of micronutrients such as vitamin A, iron, and zinc. Consequently, increasing energy and nutrient densities of gruels is a key objective of many health programs (Bennett et al., 1999; Harper & Jansen, 1985; Owino et al., 2007; Stephenson, Gardner, Walker, & Ashworth, 1994; Trèche, 1995; WHO, 1992). Extrusion cooking is one of the current technologies used for instant infant flour production. This high temperature, short time, high pressure process enables the inactivation of some of the anti nutrient factors and to ensure the hygienic quality of extruded flours. Gelatinization and dextrinization resulting from high temperatures and intense shearing during extrusion enable the preparation of gruels from extruded flours without involvement of other thermal treatments. The use of low-cost extrusion cooking has been reported since the 80 s (Harper & Jansen, 1985). A locally manufactured "Very-Low-Cost Extruder" (VLCE) was used within the framework of the Fasevie program which started in Vietnam in 1997 (Berger et al., 2004; Bruyeron et al., 2007) for the production of instant infant flour (Mouquet, Salvignol, Van Hoan, Monvois, & Trèche, 2003). Two types of product were produced:

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doi:10.1016/j.appet.2009.07.002

Favina, a rice-based instant flour, and *Favilase*, a soybean-based food supplement both fortified with micronutrients.

The present study is included within the framework of an efficacy study which aimed at evaluating the impact of the two products on the nutritional status of infants. The present study is a cross-sectional food consumption survey aiming at demonstrating that these two products, the instant flour and the soya based food supplement, are effective in increasing energy and nutrient intakes of infants between 6 and 9 months of age without reducing their daily frequencies and duration of breastfeeding.

Materials and methods

Context and setting

The study was carried out from April 2002 to October 2002. The present study is a sub-study of a randomized control trial (*main study*) aiming to evaluate if improving feeding practices of infants by providing two types of micronutrient energy dense fortified foods will have a positive impact on growth and micronutrient status of infants compared with usual feeding practices. Infants from 29 villages in a rural area (Tam Ky district, Quang Nam province) in central Vietnam took part in this main study. Villages were randomly allocated to three groups, all infants from one village belonging to the same group. Infants from groups 1 and 2 received, respectively, *Favina* and *Favilase* gruels for a period of 6 months from the age of about 5 months in canteens located in the center of the villages. Group 3 followed usual feeding practices in free living conditions.

Infants

Infants enrolled in the main study were 5 months ± 15 days old, single born, exempt of apparent congenital abnormalities, still breastfed and had already started to consume CFs (*at the time of the study the Vietnamese recommendation relative to the age of introduction of CF was "4 to 6 months"*). In addition, parents or permanent caregivers of infants of groups 1 and 2 had to agree to bring their children to the canteen at least twice a day, but were free to come over as many times as they wanted.

Effects of types of gruels, age and interaction between types of gruels and age on complementary food intakes were evaluated in a sub-sample of 144 infants. To be part of this sub-sample, infants had to have at the time of the food consumption survey a weight-for-height Z-score >-2 and a height-for-age Z-score >-2.5 (*this allowed exclusion of only infants with potential abnormal growth*). Previous studies (Moursi, Mbemba, & Trèche, 2003; Vieu, Traoré, & Trèche, 2001) showed that 35 is an adequate sample size to detect a significant difference ($\alpha = 0.05$; $\beta = 0.80$) in energy intake per kg of body weight between groups of infants consuming home-made and energy dense gruels. Thus, 36 infants from each age group (6, 7, 8 and 9 months) were randomly selected over the three food groups allowing a total of 48 infants per food groups (12 infants of 6, 7, 8 and 9 months ± 1 week were studied in each food group). Infants who had suffered from disease (as identified in the morbidity follow-up of the main study) in the seven days preceding food consumption survey were not eligible.

Experimental gruels

Table 1 shows the composition of *Favina*. Mixtures of rice, soybean, and sesame seeds were extruded by the VLCE designed as part of the Fasevie program (Bruyeron et al., 2007; Mouquet et al., 2003). A mineral and vitamin premix was formulated (Table 2) to ensure that gruels had nutrient densities meeting the most recent international recommendations for 6–24-month-old children at the time of the study (e.g., 125, 7.7, 1.6 mg/10 kcal and 35 μgRE/100 kcal, for calcium, iron, zinc and vitamin A, respectively) (WHO, 1998). When prepared at the appropriate concentration (25 g Dry Matter/100 g of gruel), *Favina* gruel consistency corresponded to a viscosity of ~2 Pa s (international unit for cinematic viscosity) when measured at 45 °C with a Haake viscometer VT550 and a fluidity of 50 mm/30 s measured with a Bostwick consistometer (Mouquet, Greffeuille, & Trèche, 2006; Mouquet & Trèche, 2001). This semi-liquid consistency matches the consistency of traditional gruels prepared by Vietnamese mothers to enable an optimal intake by 6–10-month-old infants.

Table 1
Composition of *Favina* flour and *Favilase* food supplement (g/100 g).

	Favina	Favilase
Rice	51.32	–
Soybean	20.76	87.67
Sesame	5.00	–
Sugar	15.00	–
Milk	5.00	
SALT	0.70	3.10
$Ca_3(PO_4)_2$	1.17	6.10
Vitamin and mineral premix	0.80	3.10
Vanilla	0.25	–
Amylase (BAN 800 MG)	–	0.03

Table 2
Composition of the vitamin and mineral premix (/100 g).

Vitamins		Minerals	
Vitamin A (mcgER)	28000	Iodine (mcg)	312
Nicotinamide (mcg)	70000	Iron (mg)	3470
Pantothenic Ac. (mcg)	90000	Magnesium (mg)	3190
Riboflavin (mcg)	49000	Zinc (mg)	545
Thiamin (mcg)	24000		
Vitamin B12 (mcg)	29		
Vitamin C (mg)	16000		
Vitamin D (IU)	95000		

Favilase consists of a mineral and vitamin premix blended into roasted soybean flour (Table 1). This food supplement, when added to rice flour (25.6 g of *Favilase* with 74.4 g of rice flour) allows preparing gruels having similar nutrient composition than *Favina* gruel. *Favilase* contains industrial α-Amylase (BAN 800G; Novo SA, Bagswaerd, Denmark) to provide the appropriate consistency to the gruel. When prepared in a standardized way, the dry matter contents of both *Favina* and *Favilase* gruels were about 25 g per 100 g corresponding to an energy density of about 100 kcal/100 g.

Organization of the study and field logistics

Two teams of surveyors were recruited and trained. During six 4-week periods, each of the two teams measured daily intakes of gruels and other CFs of 12 infants (4 in each group). Surveyor stayed in the home of the surveyed child from waking up time until bedtime.

Just before each 4-week-period, lists of eligible infants who would reach the age of 6, 7, 8 or 9 months during the concerned period were drawn up in the three groups. From each list, two to eight infants were randomly selected and assigned to one of the two surveyor teams in such a way that each team surveyed an equal number of infants of each group in each age class during the whole survey. Infants surveyed in a period were not included in the following period. If a special meal was scheduled (e.g., birthday of a family member) or the child had been sick during preceding seven days, or the child was absent on the day of the food consumption survey, the surveyor chose another day. Parents or caregivers were allowed to give to their infants other types of CFs in addition to at

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