



## How to use local resources to fight malnutrition in Madagascar? A study combining a survey and a consumer test



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### ABSTRACT

This study aimed to understand consumers' habits and belief structures concerning local food products and to develop a new snack as a way to fight against children malnutrition in Madagascar. A large variety of natural food resources grow in Madagascar, like *Moringa oleifera* (MO) which leaves are rich in nutrients but not consumed. First, a survey conducted in four areas of Madagascar revealed that MO leaves are known for their health benefits but infrequently consumed, probably because of their low satiating power and strong odor. In the studied areas, different levels of consumption were observed, which may be linked to varying levels of familiarity with MO by the local populations, this in turn resulting from different situations regarding geographical and historical availability. In contrary, resources such as cassava are perceived as having negative effects on health but are widely consumed because they are cheap, liked by children and satiating. The second step in the study aimed to propose products that could increase MO consumption without completely changing food practices. The acceptability of snacks associating cassava roots and MO was evaluated by means of hedonic tests performed by children. Between the snacks tested, the preferred snack contained the highest quantity of MO and was sweetened. There was no effect of area on the acceptance of the formulated snacks. This work is an evaluation of the potential of MO in the diet of malnourished population.

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### 1. Introduction

Like most developing countries, Madagascar is severely affected by the problem of malnutrition, especially in rural areas (Devine, Connors, Sobal, & Bisogni, 2003; Smith, Ruel, & Ndiaye, 2005). About one out of two Malagasy children are concerned by chronic malnutrition or stunting (FAO, FIDA, & et PAM, 2014), which can lead to increased mortality or lifelong serious damage, such as reduced intellectual development, health and social problems, and reduced performance (Schroeder, 2008).

According to FAO evidence, food scarcity is the main cause of malnutrition. Scarcity may arise for two reasons: geographic inaccessibility, when food is not available, or economical inaccessibility, when food is available but too expensive for the population to buy it. However, food scarcity cannot explain malnutrition in

Madagascar because this country is characterized by a large variety and quantity of natural resources, which could potentially be sufficient to feed the whole population. Yet, these resources are not accessible to the poorest households. Economic factors might explain part of this inaccessibility (Smith & Haddad, 2001), but are not the only factors involved. Ramakrishnan and Huffman (2008) observed that poor households in developing countries spend a large part of their income on carbohydrate-rich staple foods, and neglect foods which contain protein and micronutrients. Thus, limited access to food may result not only in insufficient quantities of food consumed, but also in imbalanced intake and poor dietary quality.

In Madagascar, however, poverty alone cannot explain the predominance of the consumption of carbohydrate-rich staple foods. Rice, for example, is not the cheapest carbohydrate staple food, yet it is the food most consumed by the Malagasy people, whatever their economic status (from twice to three times a day according to Ramaroson Rakotosamimanana, Arvisenet, & Valentin, 2014). The principal meal is composed of a large quantity of rice, served with "laoka", an accompaniment made of vegetables and occasionally

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meat (Hardenbergh, 1997). During seasonal poverty (the period between the two rice harvests), the replacement of rice by cassava roots by poor rural households worsens the nutritional situation (Dostie, Haggblade, & Randriamamonjy, 2002). Cassava is the second staple food in terms of consumed quantities, after rice (Ballet & Randrianalijaona, 2011). Cassava roots contain a higher quantity of carbohydrates than rice but are poorer in other nutrients. Cassava roots are usually boiled and eaten alone, despite the fact that people are aware that these roots cannot fulfill nutritional needs (Ramaroson Rakotosamimanana et al., 2014).

This situation is one of the major underlying causes of protein-energy malnutrition. It thus seems that together with poverty, other determinants may explain malnutrition in Madagascar.

To fight against malnutrition, micronutrient supplements are generally the practical short-term solution. But in the case of chronic malnutrition, this strategy cannot suffice. A better solution to improve the diets of children in developing countries would be to focus, not on specific nutrients, but on specific types of foods (Schroeder, 2008). To this end, commonly consumed staple foods could be combined with affordable local plants. This association would have the advantage of increasing intake and balance of both macro- and micro-nutrients needed for growth and health. In Madagascar, several plants could be eligible to provide these nutrients. Among these plants *Moringa oleifera* (MO) seems to be a good candidate. MO is a wild plant which leaves are rich in vitamins, amino-acids,  $\omega$ 3 fatty acids and iron (Thurber & Fahey, 2009). This plant grows well in the Madagascar climate. It was introduced in the northern coastal areas of Madagascar, at the beginning of the twentieth century (Foidl et al. 2001). Its cultivation was first a privilege of the colonists. It did not spread to the central regions of the country until recently, when the National Office for Nutrition (ONN) heightened awareness in the population about its nutritional benefits (ONN, 2008). MO is widely eaten and highly valued in other countries like India, where numerous recipes contain MO leaves. Yet the consumption of these leaves is rather low in Madagascar. When they are consumed, they are probably prepared like other leafy vegetables, i.e. fresh leaves are fried in oil and added to water to prepare a stock used to cook rice and served with it (Chan Tat Chuen, 2010).

Among the factors underlying food choice, availability and price were reported to be the most important ones (Giskes, Van Lenthe, Brug, Mackenbach, & Turrell, 2007). For low income households particularly, food price has been shown to take precedence over all other determinants of food choice (Blaylock, Smallwood, Kassel, Variyam, & Aldrich, 1999; Glanz, Basil, Maibach, Goldberg, & Snyder, 1998). Availability and price are the elements which constitute the food acquisition power of a household. This must be distinguished from households' food acquisition behavior, that is, the desire to consume a particular food among multiple available and affordable foods. Studies conducted in developed countries have shown that persons of low socioeconomic status are generally less likely to consume healthy diets (Inglis, Ball, & Crawford, 2005, 2009). The financial cost of diets that comply with dietary guidelines has been formulated as one reason. Another explanation could be linked to knowledge about nutrition, which was shown to differ significantly between socio-demographic groups, with poorer knowledge among those of lower socioeconomic status (Butriss, 1997; Parmenter, Waller, & Wardle, 2000). Price and availability interact with past behavior or habits which are dependent on country, culture, community or family. For example, in India, whereas local populations in the east have a preference for rice, migrants from northwest India retain their cultural preference for wheat and continue to favor it, even though it is more expensive than rice (Atkin, 2013).

In addition to economic and cultural factors, the sensations

associated with the consumption of a food are important in explaining consumers' choices to eat a specific food rather than another one. These sensations are of two orders: (i) the sensations derived from the sensory attributes of the product which are mostly related to liking and preference leading the individual to choose a food (Clark, 1998) and (ii) the physiological sensations related to metabolic effects caused by the intrinsic properties of the product, such as macro-nutrient composition and satiating power. Satiating is defined as the processes that bring a meal to an end. It is closely related to sensory and cognitive factors, as well as to the sensation of "fullness". Fullness was described by participants as "feeling of food in the stomach", "stomach stretch", "satisfaction", "contentment", "energized", "focused", and "lack of the desire to eat" in the study conducted by Murray and Vickers (2009).

The respective importance of factors underlying food choice (price, availability, habit, preference, satiating properties) depends on the environment and the population or demographic group (Scheibehenne, Miesler, & Todd, 2007). All the studies cited above were carried out in developed countries. A limited number of these studies focused on low income populations (e.g. Burns, Cook, & Mavoia, 2013; Dressler & Smith, 2013) but none were dedicated in understanding food choices in developing countries. Yet such knowledge could help in fighting malnutrition by introducing new, healthy food habits.

The goal of this study was to evaluate whether knowledge about consumers' habits and representations of local food products could help introducing new food products to fight against malnutrition. Our approach was twofold. First, we designed a survey (study 1) aimed at understanding the practices and beliefs concerning the consumption of cassava roots and MO leaves on parents of Malagasy school age children in four areas (two rural and two urban areas), where food habits were previously shown to be different (Ramaroson Rakotosamimanana et al., 2014). We hypothesized that population habits, as well as products satiating properties and local availability, would be the highest determinants of cassava and MO consumption and would explain the differences in consumption of MO leaves among the areas. Secondly, we used the information collected in the survey to develop food products combining the sensory and satiating properties of cassava roots and the nutritional properties of MO leaves. For a better appropriation by consumers, our formulated products corresponded to existing practices. Three formulations containing MO and cassava roots and one formulation containing only cassava roots were evaluated by school age children via a hedonic test (study 2). We hypothesized that differences in MO availability among areas would induce different liking of snacks containing MO by children in these different areas.

## 2. Study 1: Survey on the practices and beliefs about the consumption of cassava roots and MO leaves by parents of Malagasy school age children

### 2.1. Materials and methods

#### 2.1.1. Localisation

The study was conducted in urban and rural areas in two regions of Madagascar. Analamanga is located in the central part of Madagascar. Its principal city is Antananarivo, the capital of Madagascar, (2 million inhabitants in 2011), and is characterized by a heterogeneous population. Diana, the second region, is located in the northern coastal area. Its principal city is Antsiranana (105 000 inhabitants in 2008), mostly populated by two ethnic populations. Urban areas of Analamanga (AU) and Diana (DU) mentioned in this study correspond, respectively, to Antananarivo and Antsiranana. Rural areas of Analamanga (AR) were located about 20 km from downtown Antananarivo and rural areas of Diana (DR) were

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