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Acceptability of Porridges Produced from NUTRIMO Infant Flours with *Moringa oleifera* Lam. Leaf Powder in Togo

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Abstract

The production of various types of infant foods including complementary flours of good nutritional quality contributes to fight against infant malnutrition. However, the organoleptic characteristics of porridges such as colour and consistency, due to the presence of certain ingredients, limit their acceptability. However, these porridges, as nutritious as they are, should be consumed so that children benefit from the nutrients they contain. The present study aims to evaluate the acceptability of porridges based on two infant flours "NUTRIMO", formulated at the "Institut Togolais de Recherche Agronomique", combining 5% and 10% of *Moringa oleifera* Lam. leaves powder (PFMo). These two flours were then produced with 55% maize, 25% soya, 15% rice and 5% PFMo for NUTRIMO 5% and 50% maize, 25% soya, 15% rice and 10% PFMo for NUTRIMO 10%. Porridges based on these two flours were then presented to a panel of 30 untrained mothers, recruited on the basis of their availability. The results showed an overall acceptability of 7.29 ± 0.51 on a 9-point scale for the NUTRIMO 5% flour-based porridge compared to 5.86 ± 0.40 for the NUTRIMO 10% porridge, with a significant difference in relation to the colour of the porridge ($p < 0.05$). The production of PFMo-based infant flours should therefore take into account the proportions of ingredients in order to improve the acceptability of the porridges produced in the interest of promoting the nutritional status of children.

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Keywords

PFMo, infant flours, acceptability of porridges, nutritional status of children.

Introduction

Child malnutrition in developing countries still remains a major public health problem (de Onis *et al.*, 2000 and 2007). According to the 2019 UNICEF report, in the

world, at least 149 million children under five are stunted; 52 million are wasted; 115 million are underweight; 40 million are overweight or obese; 340 million are deficient in essential vitamins and micronutrients such as vitamin A, iron and iodine (UNICEF, 2020).

In Togo in particular, more than one in four children under five (28%) suffer from chronic malnutrition, 10% of which is severe. In addition, 6.5% suffer from acute malnutrition with 1.5% in the severe form. In addition, 16% are underweight, 4% in the severe form (République Togolaise, 2014). However, the first 1000 days of a child's life are particularly decisive for its survival. Indeed, optimal nutrition during this period of life reduces the rate of morbidity and mortality, as well as the risk of chronic diseases, and therefore contributes to better development (French Ministry of Solidarity and Health, 2020; WHO, 2006a). Moreover, from the 6th month, a strictly milk-based diet no longer covers the infant's needs, particularly in terms of energy and iron, and the risk of malnutrition or iron deficiency anaemia becomes possible. It is then necessary to introduce supplementary food in the form of porridge.

Supplementary feeding is therefore essential for children after the 6th month. This period remains critical in the child's growth (WHO, 2006a) because nutritional deficiencies in early childhood cause morbidity and developmental delay that is difficult to reverse (WHO, 2006b). Dietary supplements can therefore help meet the nutritional needs of children and avoid long-term consequences. Key determinants of the high prevalence of child malnutrition include the persistence of inadequate feeding practices and poorly diversified complementary feeding. However, populations have important agricultural food resources such as cereals, pulses and leafy vegetables. Leafy vegetables in particular would contribute to solving such a problem in African populations as they are rich in micronutrients (Abukutsa-Onyango, 2007). One such leafy vegetable is *Moringa oleifera* Lam, a local plant with several uses (Yang *et al.*, 2006; Ndong *et al.*, 2007; Houndji *et al.*, 2013a). The use of this plant to improve the nutritional status of children who develop certain nutritional deficiencies has been reported in previous studies (Yang *et al.*, 2006; Houndji *et al.*, 2013b and 2018).

Furthermore, *Moringa oleifera* Lam. leaf powder (PFMo) has very good nutritional value (Yang *et al.*, 2006; Ndong *et al.*, 2007; Houndji *et al.*, 2013b). In addition, soybean, one of the ingredients of the 'NUTRIMO' flours considered in this study, has an interesting lipid content which gives it a high caloric value (Zannou-Tchoko *et al.*, 2011). This legume also contains proteins of good biological value and thus, in combination with the other ingredients, allows the flour to provide essential amino acids as well as vitamins and

minerals. Such food plants could contribute to the fight against child malnutrition, which is still prevalent in developing countries like Togo. Faced this situation, the promotion and production of infant flours based on locally available, energy-dense foods (cereals and vegetables) has been adopted to broaden the range of staple and supplementary foods. It is in this context that the "Institut Togolais de Recherche Agronomique" (ITRA) has developed several infant flour formulations including "NUTRIMO" (Paka *et al.*, 2019; Paka, 2020), which is a formulation including PFMo. The aim is to provide children with healthy flours of adequate nutritional and organoleptic quality. The present study is a contribution to this fight against child malnutrition through the evaluation of the acceptability of porridges produced with NUTRIMO flours according to the incorporation rate of PFMo. This will make possible to improve the intake of these porridges and to promote their nutritional contribution to the promotion of the health of children.

Materials and Methods

Context and period of the study

The production of flour was carried out in a workshop at the "Institut Togolais de Recherche Agronomique" (ITRA), Lomé-Togo in December 2020; and tests at the CHP Kpalimé nutritional recovery center.

Production equipment

The equipment used consisted of drying tables, a sorting table, a roaster, a mill, a scale, a welding machine, plastic bags and small kitchen equipment.

Vegetal material

The vegetal material used consisted of seeds of Maize (*Zea mays*), Soya (*Glycine max* (L.) Merr.), Rice (*Oriza sativa*) and the powdered leaves of *Moringa oleifera* Lam (PFMo).

Two compositions were then made from these ingredients. The first one includes 55% Maize, 25% Soya, 15% Rice and 5% PFMo. This composition made it possible to obtain NUTRIMO 5% flour. The second composition consists of 50% Maize, 25% Soya, 15% Rice and 10% PFMo. This resulted in NUTRIMO 10% flour.

The maize, soya and rice were purchased on the market in Lomé, while the *Moringa oleifera* Lam. leaves were

harvested in the village of Hanyigba in Kpalimé (south-west Togo).

Treatment of raw materials

The Moringa leaves were sorted, washed, drained and then dried in the shade in a well-ventilated room at room temperature (25-28°C).

Through a manual process and using sorting tables and basins, the Maize, Soya and Rice were first sorted and then winnowed and washed. This series of operations removed dust, plant debris, mouldy seeds, stones and seeds other than those under consideration. The washing was done by stirring the products in water in a basin to remove impurities. A basket with suitable mesh was used for draining after washing.

Production of Nutrimeo 5% and 10% flour

The production consisted of 6 basic steps, namely cleaning, roasting, milling, sieving, weighing and packaging. All ingredients were mixed before milling (Figure 1).

Organoleptic and acceptability tests of NUTRIMO 5% and 10% flour porridges

A panel of 30 untrained lactating women with children between 6 months and 2 years of age was recruited on the basis of their availability. This type of panel was considered to have the capacity to assess young children's preferences for complementary foods. Samples of NUTRIMO 10% flour-based porridges were presented to each panelist on the first day. The next day, samples of NUTRIMO 5% flour porridges were presented to the same panel. The perceived enjoyment of each of the selected traits was rated by each panelist on a 9-point hedonic scale. The two porridges were then assessed on a 5-point scale, namely physical appearance (consistency), colour, flavour, aroma and overall acceptability. Scores ranging from 9 (extremely pleasant) to 1 (extremely unpleasant) were assigned to the different scale items. Prior to participation, participants were interviewed about the purpose of the study. A consent form was read and translated into the local language to obtain consent from each participant. Acceptance to participate in the study was evidenced by signing the consent form.

Statistical analyses

Data were entered using Excel 2010 and processed using GraphPad Prism version 8.00. The differences were considered significant at the 5% level ($p < 0.05$).

Results and Discussion

Production diagram for NUTRIMO 10% and 5% flours.

The production diagram for these flours is shown in Figure 1

Porridges preparation process

The preparation of the porridge was done using one part flour to three parts water as described in figure 2.

The analysis of the scorecards showed that the porridge based on NUTRIMO flour enriched with 5% PFMo was better accepted than that based on flour enriched with 10% of the same powder. The sensory criteria that influenced the acceptability of the porridges were flavour, aroma, physical appearance (consistency) and especially colour. The porridge based on NUTRIMO 5% flour was judged interesting by all consumers with an overall acceptability of 7.29 ± 0.51 on a 9-point scale, compared to 5.86 ± 0.4 for the porridge based on NUTRIMO 10% flour, with a significant difference in relation to the colour of the porridge ($p < 0.05$).

The results of the descriptive tests show that the acceptability of the porridges varies in proportion to the quantity of *Moringa oleifera* leaf powder incorporated. NUTRIMO 10% is a fairly interesting food supplement from a nutritional point of view, given the virtues of *Moringa oleifera* leaves (BoukaGoto *et al.*, 2015).

Nevertheless, it has some limitations related to the green colour less appreciated by mothers who feed their children from selected foods. This finding was also made by Paka *et al.*, (2019). The acceptability of complementary foods by mothers increases their use for children. Beyond reducing the amount of *Moringa oleifera* leaf powder, another solution to these constraints could be the production of another variety of flour still based on Moringa (NUTRIMO) where the flavour and green colour will no longer be too pronounced, but which would retain its nutrients and be appreciated by the target group (Paka, 2020).

Fig.1 Diagram of the production processes of the NUTRIMO flours under consideration

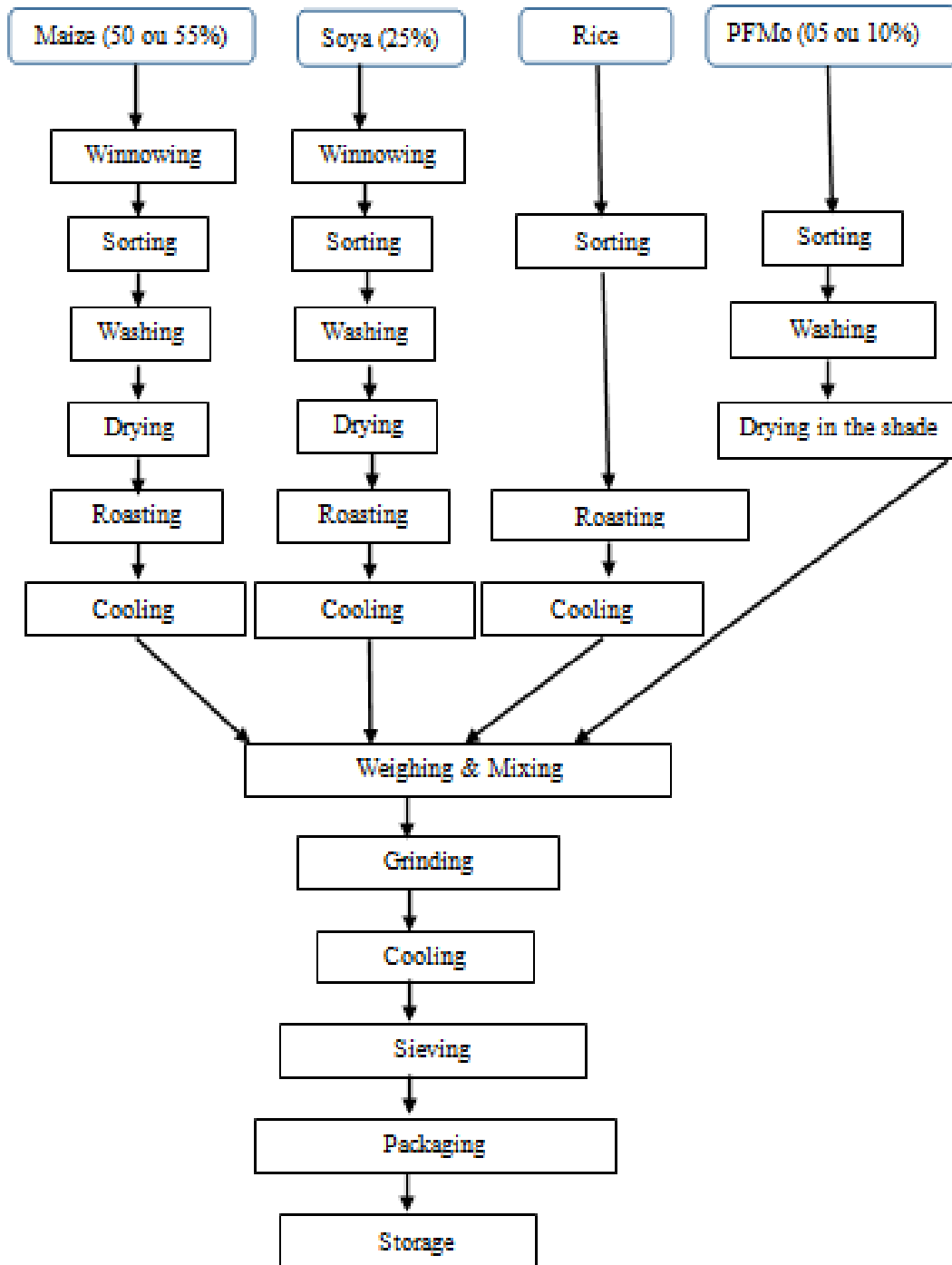


Fig.2 Diagram of porridge preparation with NUTRIMO flours considered

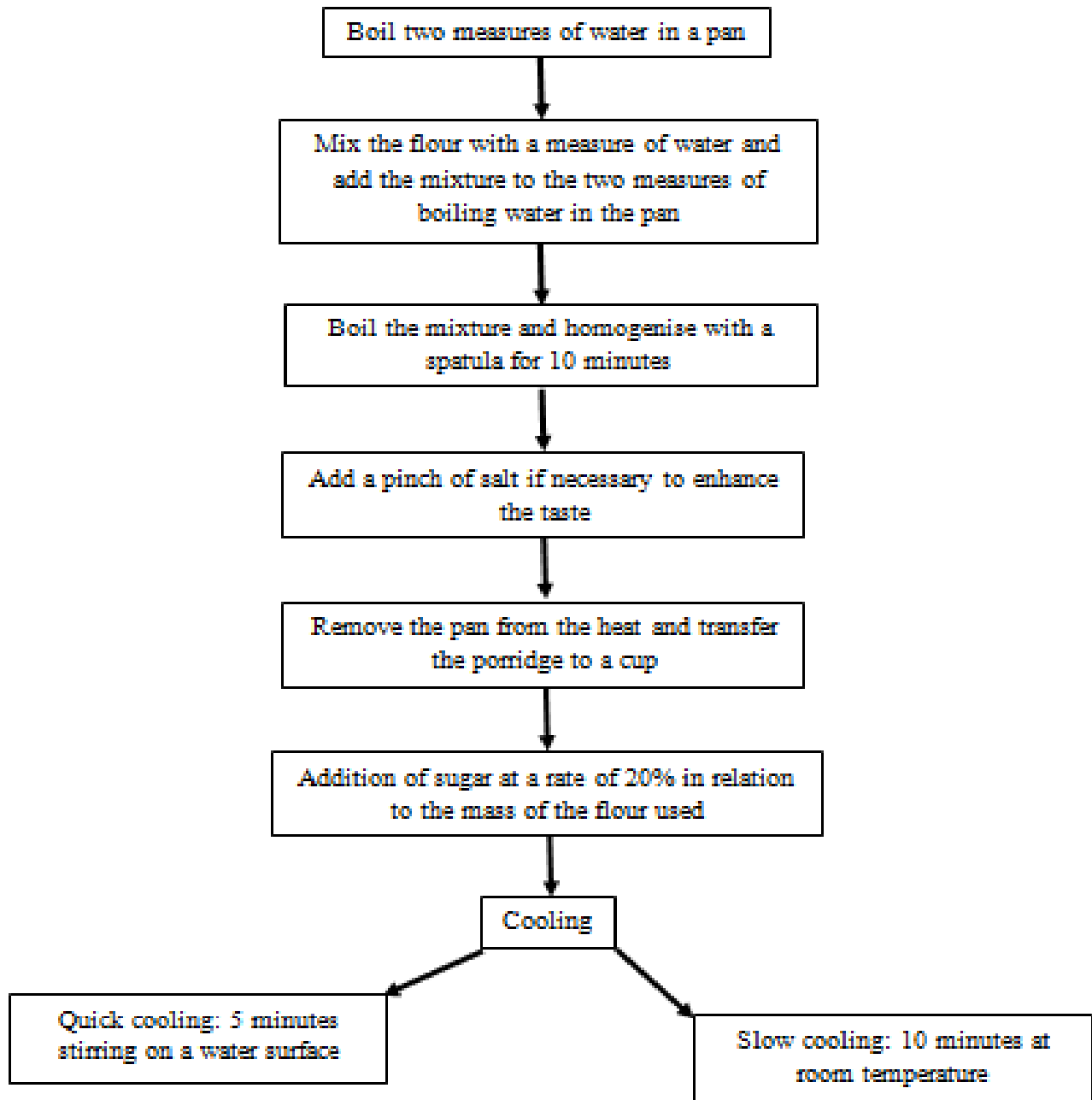


Fig.3 Diagram illustrating the scores of the organoleptic characteristics considered

Acceptability ratings for porridges based on NUTRIMO 10% and 5% flours

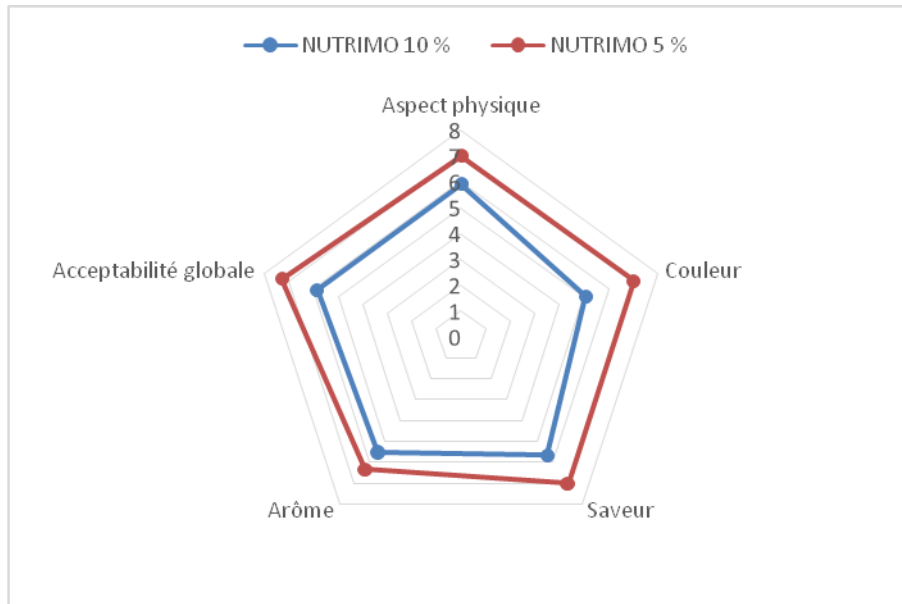
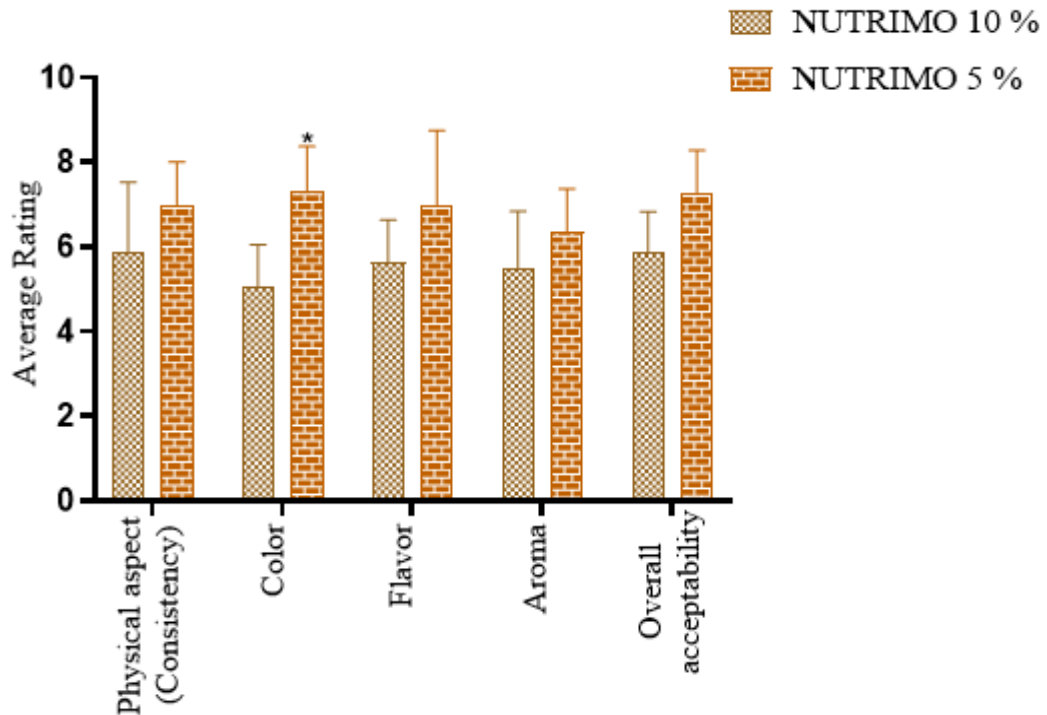


Fig.4 Comparison of organoleptic scores for porridges based on NUTRIMO 10% and NUTRIMO 5% flours



Data were expressed as mean ± MSE (n = 30). Statistically different (NUTRIMO 5% vs. NUTRIMO 10% porridge), *: p < 0.05

The results obtained were in agreement with those of Zongo (2012) who proposed 5% of the Moringa leaf powder after having revealed, together with the Burkinabe Association of Misola Units (ABUM) and Moringa news that, the 10% proportion seems too high for a better acceptability of the porridges produced.

The production of PFMo-based infant flours should therefore take into account the acceptability of the porridges to children and their mothers in order to contribute effectively to the fight against child malnutrition.

This study has enabled us to assess two types of infant flours produced from locally available and accessible products for households. The parameters influencing the acceptability of the porridges allowed the development of suitable infant flours from cereals, legumes and *Moringa oleifera* leaf powder.

The overall acceptability of the presented porridges shows that the porridges were variously appreciated. However, the flour porridge formulated with 5% *Moringa oleifera* leaves was judged quite interesting at 7.29 ± 0.51 on a 9-point scale compared to the set of 30 untrained panelists considered. Consideration of this proportion will then improve the acceptability of the porridges by the children and thus promote their nutritional status.

Ethical consideration

The authors state that they have respected all ethical considerations in this study.

Sources of Support

None

Declaration of Competing Interest

The authors report no declarations of interest.

Author Contributions

Conceived and designed the experiments: Mélila Mamatchi, AnkeKossi, Dossou Bayi Reine, and Paka Essodolom; Analyzed the data : Mélila Mamatchi, N'Webida Piting, AnkeKossi and Paka Essodolom; Wrote the paper : Anke Kossi, Mélila Mamatchi, Dossou Bayi Reine, Paka Essodolom and Mensah Labité

Komlan; Contributed reagents/materials/analysis tools : Paka Essodolom and Amouzou Kou'santa.

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References

- Abukutsa-Onyango M. (2007): The diversity of cultivated African leafy vegetables in three communities in western Kenya. *African Journal of Food Agriculture Nutrition and Development*, 7(3): 15.
- BoukaGoto C. E., Bangana A., Sidi-Touré S. (2015): Fortification of baby with local foodstuffs, in: *Grains for Feeding the World*. Presented at the EXPO MILANO 2015, Le Università per expo 2015, Comitato Scientifico Del Comune Di Milano, Milan, Italie, pp. 29–34.
- de Onis M., Frongillo E. A., Blössner M. (2000): Is malnutrition on the decline? An analysis of the evolution of child malnutrition since 1980. *Bulletin of the World Health Organization*, 78(10): 1222-1233.
- de Onis M., Onyango A. W., Borghi E., Siyam A., Nishida C., Siekmann J. (2007) : Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 85: 660-667
- Houndji B. V. S., Ouetchehou R., Londji S. B. M., Amouzou K. S. E., Yehouenou B. (2013^a): Microbiological and physicochemical characterization of leaf powder of *Moringa oleifera* (Lam.), a traditional leaf vegetable in Benin. *Int J Biol Chem Sci* 7: 75-85.
- Houndji B. V. S., Bodjrenou S. F., Londji S. B. M., Ouetchehou R., Acakpo A. and Amouzou K. (2013^b): Improving the nutritional status of children aged 6 to 30 months in Lissèzoun (Central Benin) with *Moringa oleifera* leaf powder (Lam.) *Int J Biol Chem Sci* 7: 225-235.
- Houndji B. V. S., Melila M., KoukoubouNago E., Fagla Amoussou B., Awaga K. L., Ahoton P., Ahohuendo C. B. and Amouzou K. (2018) : Pharmacological Effects of *Moringa oleifera* (Lam.) Leaves Powder in the Treatment of Anaemia in Children Aged from 6 to 30 Months in Lissezoun in Central Benin. *Biochemistry & Physiology (BCP)*, 7(2): 1000239.

- French Ministry of Solidarity and Health / "First 1000 Days" Commission. (2020): The first 1000 days, where it all begins; Report of the 1000 first days commission, September 2020. Available online at: <https://solidarites-sante.gouv.fr/IMG/pdf/rapport-1000-premiers-jours.pdf>. Accessed 05 November 2021.
- Ndong M., Wade S., Dossou N., Guiro A. T., Gning R. D. (2007): Nutritional Value of *Moringa Oleifera*, Study of Iron Bioavailability, Effect of Fortification of Various Senegalese Traditional meals with Leaf Powder. African Journal of Food, Agriculture, Nutrition and Development, 7 (3): 1 - 17.
- WHO (2006a): Guidelines for feeding non-breastfed children aged 6-24 months. Geneva, Switzerland: World Health Organization.
- WHO (2006^b): WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: World Health Organization, 312p.
- Paka E. (2020): Improvement of the nutritional and organoleptic quality of supplemental flours produced in Togo from local foodstuffs. PhD thesis in biochemistry applied to nutrition and food, University of Lomé, (Togo); 112p.
- Paka E., Boyode P., Mélila M., Houndji B. S. V., Bilabina I., Amouzou K. (2019): Physico-chemical characteristics of infant supplement flours produced by the Institut Togolais de Recherche Agronomique (ITRA), Afrique Science, 15(1): 71-82.
- République Togolaise, Ministère de la Planification, du Développement et de l'Aménagement du Territoire (2014): Third Togo Demographic and Health Survey (EDST), 505p.
- UNICEF. (2020): For every child, reinventing the future. State of the World's Children Annual Report 2019; Paris, 68p.
- Yang R. Y., Tsou S. C. S., Lee T. C., Chang L. C., Kuo G. and Lai P. Y. (2006): Moringa, a novel plant rich in antioxidants, bioavailable iron, and nutrients. In: C. T. Ho (ed) Challenges in Chemistry and Biology of Herbs. American Chemical Society Series, Washington, D.C. 925: 224-239.
- Annou-Tchoko V., Ahui-Bitty L., Kouame K., Bouaffou K., Dally T. (2011): Study of the nutritional value of cassava and soybean-based infant flours for weaning age children. Bulletin de la Société Royale des Sciences de Liège, (80): 748 - 758.
- Zongo U. (2012): Study of the evolution of clinical and biological parameters of vulnerable children whose diet includes Moringa leaf powder. Dissertation of DEA in Biotechnologies: Option: Human Nutrition and Food Toxicology, UFR-SVT, University of Ouagadougou (Burkina Faso), 59p.

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