RUFORUM Working Document Series (ISSN 1607-9345), 2021, No. 19 (1): 531-539.
Available from http://repository.ruforum.org

Research Application Summary

Sensory and sociocultural acceptability of lucky iron fish in Republic of Benin

Gnamlin, L., Achamou, M., Boyiako, B.,[1,2]* Adoukonou, A. & Fanou-Fogny, N.

[1]School of Nutrition, Food Sciences and Technologies, Faculty of Agronomic Sciences, University of Abomey-Calavi, 01 BP 526 Cotonou, Benin
[2]Laboratory of Food Nutrition and Technology, Faculty of Engineering, University of Eduardo Mondlane, Maputo, Mozambique
***Corresponding Author**: bernadetteboyiako@gmail.com

Abstract

Iron deficiency anemia, is the most widespread nutritional disorder; affecting more than 50% of children and women of reproductive age in Benin. Despite the effort made by Benin' Government, the problem is still increasing. A recent approach is Lucky Iron Fish: LIF (fish-shaped cast iron ingot used to provide dietary supplementation of iron). This research was undertaken in center and south part of Benin, to assess the sensory and sociocultural acceptability, and factors that could affect the use of LIF and it adoption. The present work was an 18 months longitudinal experience, based on semi-randomized non-blinded study design and made use of personal structured interviews and focus groups as data collection tools. Sensory acceptability was carried out on 46 mothers of children, to evaluate their appreciation on stiff maize pasta and tomato soup cooked with LIF; using hedonic test. A qualitative approach was used through household survey (N=125), to research sociocultural acceptability (participants' perception, knowledge, constraints and barriers related to the use of LIF). Results highlighted that overall all women had a positive appreciation on the two foods prepared with LIF in terms of color, consistency and smell aside from soup for 90% due to the very spicy taste with some women. The cooking conditions added to some religious and cultural beliefs was the factors that affected the adoption of LIF with some women. However, a significant improvement on nutritional education session of LIF is needed.

Keywords: Constraints and barriers, dietary supplementation of iron, iron deficiency anemia, knowledge, perception, women of reproductive age

Résumé

L'anémie ferriprive est le trouble nutritionnel le plus répandu; touchant plus de 50% des enfants et des femmes en âge de procréer au Bénin. Malgré les efforts déployés par le gouvernement béninois, le problème continue de s'aggraver. Une approche récente est Lucky Iron Fish : LIF (lingot de fonte en forme de poisson utilisé pour fournir une supplémentation alimentaire en fer). Cette recherche a été entreprise dans le centre et le sud du Bénin, pour évaluer l'acceptabilité sensorielle et socioculturelle, et les facteurs qui pourraient affecter l'utilisation du LIF et son adoption. Le présent travail était une expérience longitudinale de 18 mois, basée sur une conception d'étude semi-randomisée non aveugle et a utilisé des entretiens personnels structurés et des groupes de discussion comme outils de collecte de données. L'acceptabilité sensorielle a été réalisée sur 46 mères d'enfants, pour évaluer leur appréciation sur les pâtes fermes de maïs et la soupe de tomates cuites au LIF ; en utilisant le test hédonique. Une approche qualitative a été utilisée par le

biais d'une enquête auprès des ménages (N = 125) pour rechercher l'acceptabilité socioculturelle (perception des participants, connaissances, contraintes et obstacles liés à l'utilisation du FRV). Les résultats ont mis en évidence que globalement toutes les femmes avaient une appréciation positive sur les deux aliments préparés avec LIF en termes de couleur, de consistance et d'odeur mis à part la soupe pour 90% en raison du goût très épicé chez certaines femmes. Les conditions de cuisson ajoutées à certaines croyances religieuses et culturelles ont été les facteurs qui ont affecté l'adoption du FRV chez certaines femmes. Cependant, une amélioration significative de la séance d'éducation nutritionnelle du LIF est nécessaire.

Mots clés : Contraintes et barrières, supplémentation alimentaire en fer, anémie ferriprive, savoir, perception, femmes en âge de procréer

Introduction

Iron deficiency is the main cause of anemia, a public health problem in both rich and poor countries. Children and women are the most affected by this disorder (MPDINSEA, 2017). The prevalence of anemia is 72% in children (6-59 months) and 58% in women (15-49 years) in Benin (MPDINSEA, 2017). Despite the different efforts to address it, iron deficiency anemia remains increasing (De Benoist, 2008). This situation is owing to the limitations of some of the implemented interventions: adverse side effects of oral iron supplements and the cost associated with fortification and supplementation programs in resource-poor settings (MSY *et al*., 2016).

Research reported that iron-cooking pots were used to treat iron deficiency anemia (Geerligs *et al*., 2003). Since then, a series of randomized controlled trials were conducted in many developing countries to expand the results to humans and paved the way for this novel iron supplementation technique. However, compliance with the novel technique was not as successful as expected. Women reported that iron cooking pots are heavy, difficult to clean (they rusted easily), chipped, easily breakable when dropped, and expensive (Tripp *et al*., 2010). This concept, improvement of iron status using adventitious sources of iron, was later reviewed and resulted in the proposal of Lucky Iron Fish (Park *et al*., 2000; Armontrong *et al*., 2017).

The use of Lucky Iron Fish is an effective and affordable means of improving iron intake in developing countries Armontrong *et al*., 2017). The fish is mainly made of ferrous iron and best releases bioavailable iron when boiled with iron absorption enhancers (ex: lemon) for at least 10min/fish (Charles *et al*., 2011). The consumption of 1L of lemon water prepared with an iron ingot provides up 75% of the daily iron requirement. (Charles *et al*., 2011). Given the positive results of these trials, the use of Lucky Iron Fish to handle iron deficiency anemia should expand to other countries. Before that, some compliance factors are yet to be well researched. The main purpose of the present study is to evaluate the sensory and socio-cultural acceptability of Lucky Iron Fish among women of reproductive age in the Republic of Benin.

Materials and methods

Study design: The present study was conducted from October 2018 to December 2020 in six communes (Abomey, Adjohoun, Cove, Djakotomey, Dangbo and Abomey Calavi) grantees of a project called Collective Impact for Nutrition (C4INP/P4P) in Benin Republic. This project was implemented by the international NGO CARE Benin/Togo and aimed at addressing micronutrients deficiencies through one of its activities, which consisted of distributing the Lucky Iron Fish (LIF) to iron deficiency-vulnerable women. The study was based on semi-randomized non-blinded study

design and made use of personal structured interviews and focus groups as data collection tools.
Participants and sampling: Participants are, women of reproductive age (WRA), grantees of the‘C4INP/P4P project’s program. Forty-six (46) mothers of children were recruited from the ‘‘Hospital de Zone’’ of Abomey-Calavi for sensory acceptability. To better assess the women’s compliance towards the use of LIF and their perceptions; 125 WRA was considered sufficient. This consideration was based on a statistical test power (β) of 80%, representing the probability of the smallest significant difference between the two treatments; a significance level of 5% and a non-response rate of 10%. Regarding the socio-cultural acceptability, women members of VSLA (Village Savings and Loan Associations) were selected during the baseline survey based on some inclusion and exclusion criteria (Rappaport *et al*., 2017) and were 75 in each commune of the study to participate in focus group sessions. They were given LIF and instructions related to its use and received nutritional education.

Data collection: LIF sensory acceptability, compliance and socio-cultural acceptability data were collected with ODK software.

Sensory evaluation and acceptability: The two most consumed meals; stiff maize paste (semi-solid) and tomato soup (liquid) were cooked following the most common recipe with LIF added to the cooking water. Sensory evaluation of the two food matrices was done using the hedonic test based on a five Likers scale (from " hate a lot " to " like a lot ‘‘).

Sociocultural acceptability: A qualitative approach was used to research the sociocultural acceptability of LIF. For this purpose, a three-stage optimization activity was performed: i) development of data collection tools, ii) use of personal and group interviews as data collection method and, iii) data processing and analysis. Women enrolled for group discussions were categorized into two groups: women who received LIF and those who did not, respectively selected from the treatment group and control group. The household’s size [5 (nuclear family) and 7 (large family)] and duration of LIF use was the main selection criteria. As for personal interviews, the two groups of participants were: i) Health workers/community relays; Learning Practice Alliance for Advocacy (LPAA) member, ii) Facilitators and Interns of the CI4N/P4P/LIF project on sites.

Overall, six (06) focus groups and fourteen (14) personal interviews were done. Data collected were about the community knowledge of the situation of iron deficiency anemia, the introduction of LIF in the community and its use, setback and constraints affecting its ownership, the relationship between stakeholders on the field and the follow-up in the use of LIF by beneficiary women.
Data analysis: Data was processed in three steps: focus group transcription, data processing and analysis. Focus groups were recorded and rendered more understandable to ease analysis. Personal interviews underwent content analysis as well. Information was processed per target's category.

Results and discussions

Height-hundreds-height (808) women of reproductive age (15- 49 years old) were assessed to the baseline survey. Out of the 125 women who were selected to follow three series of survey, 40 completed it. Reasons explaining such decrease was that some women got pregnant, some relocated and others withdrew from the study under the influence of their spouse or other influential people in their household or neighborhood. As to another component of the study, the number of respondents remained unchanged. The decreasing observed in this work is similar to the study carried out by Pasricha *et al*., (2014) on the iron supplementation benefit its physical performance

in women of reproductive age. They highlighted that 65 titles screened for eligibility, only 36 were finally identified due to some bias meet during the follow-up.

Sensory acceptability: The results of the sensory acceptability of the two foods prepared with LIF is shows in Figure 1. Overall, all the women had a positive appreciation on the stiff maize paste (solid) and the soup (liquid) prepared with LIF in terms of color, consistency and smell aside from soup for 90%. This difference was attributed to the very spicy taste of the soup with some women. The same trend was observed for the global appreciation of the two foods. This result is in agreement with the studies conducted by Park *et al*. (2000); on the iron content, sensory evaluation, and consumer acceptance of food cooked in iron utensils. They reported that the use of iron pot in the cooking process of hamburger patties (more solid than applesauce) does not affect the sensory quality. Moreover, Armontrong *et al*. (2011), and Rappaport *et al*. (2017) found the same observation on iron release from the Lucky Iron Fish, safety considerations. It was concluded that boiling one fish in water did not affect it perception. More than 95% of the women reported that the water that had been boiled with no or one fish was drinkable: no smell, color nor taste was affected. We have had a lower percentage and this could be due to the fact that foods matrices upon which was based our assessment are complexes and the presence of other ingredients except for LIF could be a factor of bias.

In contrary, during the frequency home use of LIF, women reported changes in the food's color, taste and smell during the cooking process. The smell was the most reported change (51.77%). In their opinion, the food's smell and that of an iron supplement called "fer foldine'' were alike. Other reported change was the taste (37.59% of women). It said that the taste of foods prepared with LIF is somewhat sour. Study reported that using one LIF during cooking process does not affect the sensory quality but affected the color, taste, and flavor and decreased the acceptance/ preference of the applesauce (Park *et al*., 2000). Indeed, the foods organoleptic characteristics upon which changes occurred are the same but we cannot assume that the results are the same given that studies were based on neither strictly the same objects nor the same process of sensory evaluation.

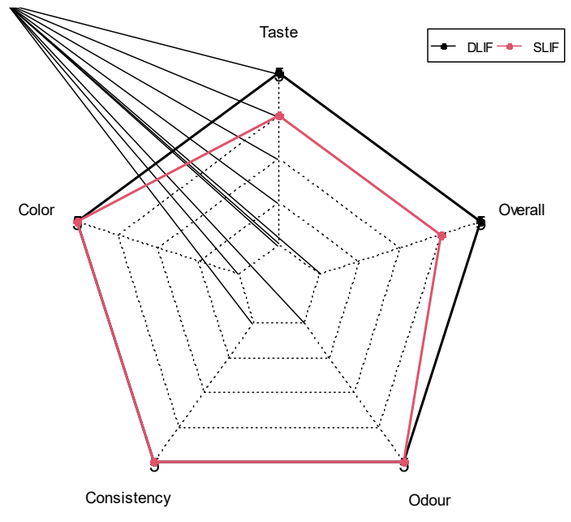

Figure 1. Sensory acceptability of foods made with LIF (DLIF= stiff maize paste made with LIF; SLIF= sauce prepared with LIF)

Sociocultural acceptability: Knowledge about LIF and its introduction into the community

All the participants met during focus groups and individual interviews on the survey sites were able to describe LIF. Its composition and health usefulness has been variously assessed:

> *"...LIF is an iron fish that we have been given and which enables us to heal from the lack of iron in the body..."* (Catalyst at Adjohoun). *"...What I know about LIF, it is the fer foldine (an iron supplement drug), a fish-shaped iron, meant to help address the lack of blood..."* (Mother of four children, Focus Group Participant, Djakotomey). *''They told us that it is a fer foldine, easily usable in meals and which enables to heal from a lot of small ailments such as fatigue, dizziness, pale eyes and the lack of blood."* (Mother of four children, Focus group participant, Todé).

Regarding LIF introduction, it was organized a commune-level meeting with catalysts and executives of the NGO Care International in the presence of communes officials, religious leaders, resource persons of the health system (head doctor, midwife) and the LPAA platform members. The same was done in Covè and Djakotomey with the above-mentioned persons. Thereafter, a series of culinary demonstrations have been conducted to help participants get familiar with LIF and its use.

> *''They first called catalysts and the mayors' secretaries to show it to them and it is on another day they came to introduce it to the group…They cooked porridge with the iron fish and other meals that we consumed together. They convoked all the women's groups of other villages on that day, and it is at that moment they show to the grantees, the different steps and the process of LIF preparation."* (Focus group participants, Dangbo).

At Covè and Djakotomey, local leaders were asked to sensitize men and households' heads during the LIF introduction process. LIF reception has therefore been done in the presence of beneficiary women's spouses and with their approval.

> "Back from the first information meeting, community leaders talked to households' heads to reassure them that LIF is neither a poison nor a witchcraft product from their wives." (Catalyst, Djakotomey). *"....It is the household's leader who comes to sign, collect the LIF and allows his wife to use it in the household. Some women have not yet come to withdraw the LIF so far because their husband did not approve."* (Catalyst and community relays, Covè).

In Dangbo and Adjohoun communes, households' heads were not aware of LIF introduction in their households. This resulted in the fluctuation of the LIF frequency of use (described earlier on) and the difficulties (to be described) in the use of LIF. Below is the testimony of a knowledgeable person:

> *"....Some mistakes were made during the LIF introduction in Adjohoun; husbands were not consulted before the LIF distribution and many have strictly prohibited their wife from using it. (Intern, Adjohoun).*

Representations of LIF and its perception in the community

Focus group participants in the community perceive LIF in two distinct ways. Some saw it as ''a gift of the NGO CARE International Benin/Togo to its Fafawa women's groups." others think that the introduction of LIF product comes from ''the assistance that the NGO CARE International Benin/Togo has decided to provide to women to fight against iron deficiency/anemia" which is a health problem they faced.

''The iron fish is a reward that CARE officials have given us to encourage us regarding our good attitude and assiduity in the activities that we conduct with facilitators on our groups. We are happy." (Focus group participant, Adjohoun). ''LIF product is a biological iron and not a steel iron like some think and brought by the NGO CARE to improve the women's health in the fight against anemia." (Focal point of nutrition, Covè.)

Focus groups participants of all the visited sites, after the use of LIF, stated that ''LIF is a beneficial product''. Even better, women of the villages that did not receive LIF yet, praise it based on the testimonies of grantees of their experimentation sites or group.

''Among those who do use LIF, there is an improvement for their children. Over here, we have at least 07 cases of women who use to go to hospital many times for blood transfusion to their children. Since five (05) months that they received the product and used it, they have not gone to the hospital for blood transfusion so far). (Catalyst Djakotomey). ''Before LIF, my weight was not normal and I often had health issues, but it improved, LIF improved my appetite and I am feeling better. (Catalyst, Dangbo).

To other survey targets members of the LPAA platform, LIF is ''a product to be used in the treatment of chronic anemia but in addition to another one''. From their viewpoint based on personal experimentation, they stated that LIF could not solely cover body needs as recommended by sanitary norms.

''...The product has the ability to provide the body with iron. However, a significant improvement in the situation has not yet been noticed. Pregnant women coming from villages continue to be diagnosed anemic with a very low blood Concentration of 3mg/l while the reference is 10.5mg/l for women of reproductive age..." (LPAA President, Covè).

Opinion upon the preference between the use of LIF and the ingestion of Syrup/iron tablets to hamper iron deficiency/anemia are divergent. While some grantees state that the use of LIF is more convenient than the purchase and the ingestion of the ferrous tablets, others claim that ferrous syrup/tablets ingestion is rather a less compelling method than the use of LIF is.

''We prefer the iron fish to other tablets; it is always easy to prepare whereas tablets, women forget more often to take them." (Focus group participant, Dangbo). "Tablet is easier because we just have to take it with water; the other required fire first then the conditions of use. It is a long process." (IA, PBI Adjohoun)

Aside from some physical traits of the fish that are berated by participants and LPAA platform members, interviewees have unanimously admitted that the shape of LIF posed no problem of acceptance. Regarding the use of LIF, no interviewee complained about its side effects.

The use of LIF requires as conditions: a strict quantity (1liter) of water for the meals, the availability of acidifying ingredient (lemon, vinegar, and tomato), and immersion of the product during 10min before the end of the cooking process. These conditions to be met are to some extent mentioned as constraints that limit the use of LIF. The following assertions tell more about the LIF use-related constraints:

''The use of the fish is not always easy. When lemon gets scarce, we do not use the LIF that much. Even tomato is not easy to get every time. The use of ferrous fish is easier in the middle of porridge preparation with fermented water than it is with other culinary preparations; now one cannot take porridge at every mealtime." (Focus group participants, Adjohoun). ''Most of the women struggle to estimate the needed time for LIF to release the required quantity of dietary iron during the cooking, even if they say that cell phones' clocks help them. We do not all master cell phones' clock. We try but the compliance to the condition is difficult." (Catalyst, Adjohoun).

According to participants, the three times consumption frequency of LIF a day proved to be constrain because most of the households in their community do not get or cook three meals a day. "We have been trained three months ago to monitor the grantees, and it was said that. LIF should be used 3times a day. The number of times that most of the households over here cook a day is one; mostly the diner. At that time, they try to use it in the stiff paste and soup. Nevertheless, the instruction is tough to apply, it is very common to eat the leftovers of the previous day or to purchase the breakfast from outside and it is only in the evening we cook." (Catalyst, Adjohoun). ''The constrain we faced at our arrival: the use of one LIF for a preparation meant for many people. In the face of such a puzzle, some women resolve to use LIF for small preparation and this sometimes." (LIF intern, Djakotomey)

The two others mentioned constraints especially by Adjohoun's grantees is the adoption of new dietary patterns (since October 2020) and the taste of the prepared drinking water. They state that this mode of making LIF part of the drinking water causes hunger. It increases the quantity of food to consume and the frequency of consumption while they do not have enough foods.

"The new model of LIF product use is quite hard. Preparing the drinking water with LIF and drinking it causes hunger. One should own a meal, which one can eat at many sequences. However, we cannot say that we have foods every day." (Focus group participant, Adjohoun). "When they told us to immerse LIF in 1liter porridge, I did it but the smell is unpleasant. I could not do it every time." (Focus group participant, Adjohoun).

''When we cook LIF in stiff paste, jollof rice or soup, the foods are tasteless. In the tap water, as they told us, the water has an unpleasant taste on the tongue." (Focus group participant, Adjohoun).

''Ogou'' religious affiliation can as well be a cultural barrier to the adoption of the dietary habit described by some beneficiary women. In reality, in that religion, it is forbidden to use any iron object as a food ingredient. They can therefore not use the iron fish in their household (especially in Adjohoun and Covè).

''In my area, constraints are related to the shape of the fish. Women belong to families within which the use of metallic iron as a food ingredient is under the ban because iron is related to the divinity 'Ogou'" (LIF interns, Covè). ''Among grantees, it is believed that the metallic iron of the fish will leave residues in the body and will thus limit the fertility of women."

After the distribution of LIF in Adjohoun, reluctances and refusals were recorded towards the use of the product in households. Investigations in the study target revealed that refusals and reluctances were caused by widely accepted ideas in the community, which where ''LIF is endowed with an evil spirit meant to harm."

Other ideas were based on the sign S present on the fish, which was seen as a snake for which women will later be turned as prey for sacrifice purpose.

''Some of our women who do not belong to our Fafawa groups have started saying that it is

a fish-shaped iron object presenting a snake sign which is linked to a marine snake, a 'mami wata' divinity that will take us to sea. Many of us did not use it during the first months of fear. '' (Focus group participant, Adjohoun).

We should clarify that all these beliefs/ideas and practices have contributed to hampering LIF adoption after its distribution on the sites of Adjohiun and Dangbo. Sensitizations are in progress, the follow up enhanced by house visits done by CARE project' facilitators and catalysts helped to reinvigorate the use of LIF.

Conclusion

With a high unstable rate of compliance 89-97%, LIF did not affect sensory qualities (taste, color, smell, and consistency) of the foods prepared. In the community, due to its positive effect, LIF use is perceived by most of the respondents as quick and effective means to address anemia. However, there is a minority of women who do prefer iron supplement pills ''fer foldine" to LIF because deemed less demanding in terms of use. Religious and cultural beliefs and acidifying seasonal scarcity such as lemon and tomato are some of the barriers to overcome for LIF to be wildly spread.

Acknowledgement

The author's thanks Lucky Iron Project (LIF) found by International CARE Benin/Togo, and all professors and assistants of Laboratory of Nutrition, Faculty of Agricultural Sciences, University of Abomey-Calavi; Republic of Benin, who contributed to the success of the present research. This paper is a contribution to the Seventh Africa Higher Education Week and RUFORUM Triennial Conference held 6-10 December 2021 in Cotonou, Benin.

References

Armstrong, G. R. 2017. The lucky iron fish: a simple solution for iron deficiency. *Blood Advances* 1:330–330. https://doi.org/10.1182/bloodadvances.2016000521.

Charles, C. V., Dewey, C. E, Daniell, W. E. and Summerlee, A. S. 2011. Iron-deficiency anaemia in rural Cambodia: community trial of a novel iron supplementation technique. *The European Journal of Public Health* 21:43–8. https://doi.org/10.1093/eurpub/ckp237.

De-Benoist, B., WHO. and Centers for Disease Control and Prevention (U.S.). 2008. Worldwide prevalence of anaemia 1993-2005 of: WHO Global Database of anaemia. Geneva.

Geerligs, P. P., Brabin, B., Mkumbwa, A., Broadhead, R. and Cuevas, L. E. 2003. The effect on haemoglobin of the use of iron cooking pots in rural Malawian households in an area with high malaria prevalence: a randomized trial. *Trop Med Int Health* 8:310–315. https://doi.org/10.1046/j.1365-3156.2003.01023.x.

MSY, L., Speedy, J., Styles, C. E., De-Regil, L. M. and Pasricha, S. R. 2016. Daily iron supplementation for improving anaemia, iron status and health in menstruating women. *Cochrane Database of Systematic Reviews* 183pp. https://doi.org/10.1002/14651858.CD009747.pub2.

Ministère du plan et du développement et Institut National de statistiques et d'économie appliquée. 2018. Cinquième Enquête Démographique et de Santé au Bénin (EDSB-V) 2017-2018, 675pp.

Park, J. and Brittin, H. C. 2000. Iron content, sensory evaluation, and consumer acceptance of food cooked in iron utensils. *Journal of food quality* 23: 205–15. https://doi.org/10.1111/j.1745-4557.2000.tb00207.x

Pasricha, S., Michael, L., Thompson, J., Farcell, A. and De-Regil, L. 2014. Iron Supplementation Benefit its Physical Performance in Women of Reproductive Age: A Systematic Review and Meta-Analysis. *The Journal of Nutrition* 144 (6): 906-914.

Rappaport, A. I., Whitfield, K. C., Chapman, G. E., Yada, R. Y., Kheang, K. M., Louise, J. 2017. Randomized controlled trial assessing the efficacy of a reusable fish-shaped iron ingot to increase hemoglobin concentration in anemic, rural Cambodian women. *American Journal of Clinic Nutrition* 06 (2): 667–674. https://doi.org/10.3945/ajcn.117.152785.

Tripp, K., MacKeith, N., Woodruff, B.A., Talley, L., Mselle, L., Mirghani, Z., Abdalla, F., Bhatia, R. and Seal, A.J. 2010. Acceptability and use of iron and iron-alloy cooking pots: implications for anaemia control programmes. *Public Health Nutrition* 13 (1):123-130.