Short Research Article

Feasibility of cassava semolina (Attiéké) as a vehicle for food fortification: A survey in areas of Côte d'Ivoire with high levels of childhood micronutrient deficiencies

ABSTRACT

Aims: This study constitutes the first approach to a food program. It was carried out in order to make up a useful database for a nutritional intervention by evaluating the level and practices of consumption of cassava semolina (Attiéké) among school children in rural communities.

Study design: This study was conducted from May 14 to 21, 2021 in elementary school in six villages in an area of Côte d'Ivoire that previously had a high prevalence of childhood anemia.

Methods: A cross-sectional survey collected data from first- to sixth-grade school children and aged from five to fifteen years (n = 460). Children provided data on their cassava semolina consumption in response to individual structured interviews conducted in their elementary schools and in the presence of one of their parents.

Results: The results suggest that cassava semolina is an accessible, familiar and acceptable vehicle for food fortification to overcome nutritional deficits in children in this area. Cassava semolina is available throughout the year in this area. Children consumed an average of 95.5 g/day of cassava semolina and over three quarters of them (88.5%) had consumed this food on at least one day during the week prior to the survey. Cassava semolina was most often eaten for the midday meal (77.2%) in combination with fish (86.3%) and/or vegetables (79.1%). Finally, although cassava can be grown in this area, most children's families (75.9%) purchased processed cassava semolina.

Conclusion: The fortification of semolina would have high penetration in the population. However, the survey also identified a major challenge to using cassava semolina as a vehicle for micronutrient fortification. This is the shelf life of fresh cassava semolina, which is only 3 to 4 days in the absence of refrigeration.

Key words: Food fortification, micronutrient deficiencies, school-age children, West Africa, Cassava

1. INTRODUCTION

Many of the children whose development is placed at risk by micronutrient deficiencies live in West Africa [4]. For example, diets deficient in iron, zinc and vitamin B9 have a high prevalence among rural children in Cote d'Ivoire. Diets in many regions of West Africa are dominated by carbohydrates (e.g., yams, rice and cassava), with a low intake of foods rich in protein and iron (e.g., meat and beans) and other micronutrients (e.g., fruit and vegetables) [5], and consequentially, these diets are often implicated in nutritional deficiencies [6].

One public health intervention that is effective in addressing widespread micronutrient deficiencies is the fortification of staple foods [7]. A variety of grains have proven to be cost-effective vehicles for food fortification to overcome micronutrient deficiencies among African children [8,9]. However, grains are not the main source of carbohydrates in many West African diets. In many communities, cassava fills this role. Indeed, since the 1980s, cassava has supplied over one-third of caloric requirements in Africa [10]. Although the vast majority of Africa's cassava production has traditionally taken place in West Africa [10], cassava production is burgeoning across Africa. Between 1961 and 2013, cassava production in sub-Saharan Africa increased nearly five-fold, and the area under cultivation increased almost three-fold, partly due to its supplanting alternative crops, including grains [11].

In Cote d'Ivoire, cassava is widely consumed as semolina (attiéké), a granular flour produced from the roots of the cassava plant. This food can be consumed both hot and cold [12], and is widely valued across subpopulations that differ in social, cultural and geographic location [13]. However, there is a lack of research on the accessibility, familiarity and acceptability of cassava semolina among children in communities in Cote d'Ivoire that have a high prevalence of micronutrient deficiencies. This research sought to determine the current consumption of cassava semolina among rural schoolchildren in such communities, and their taste preferences, as a first step in evaluating the feasibility of fortifying this food as a means of overcome children's micronutrient deficiencies.

2. MATERIEL AND METHODES

2.1. Type of study

The survey conducted for the collection of data was a cross-sectional survey with a descriptive aim by questionnaires. It focused on the retrospective description of consumption practices of cassava semolina (Attiéké) among school children.

2.2. Area and Period of Study

This survey took place from May 14 to 21, 2021, in rural communities in the department of Issia. This department is in the central west of Côte d'Ivoire, in the Haut Sassandra region. Its climate is very favorable to cocoa, coffee, rubber, and rice, but also to other crops such as cassava, yams, bananas, corn, fruits, and vegetables [14,15]. The population of the department of Issia has increased rapidly in recent years, from 351292 inhabitants in 2016 to 410628 in 2021.

Data on the nutritional status of school children are very rare at both the regional and national levels. However, a few years back, the department of Issia had the highest incidence of anemia (164.68‰) in children aged 0-4 years in the Haut Sassandra region [16]. This situation and its consequences could persist throughout childhood or even adolescence in the absence of an effective nutritional program. Thus, six villages in the department, namely Béliéguhé, Zédéguhé, Béréguhé, Maboguhé, Dibléguhé and Guéguhé were selected. This selection was made in a reasoned way, on the one hand, because of their consent to participate in the planned nutritional intervention and because of the presence of school canteens in the schools of these villages (Figure 1). The survey was conducted in a school setting to interview most children. Since some villages have only one school in common, children from the villages of Béliéguhé and Zédéguhé (BZ) were interviewed in the Béliéguhé public elementary school (PES), those from the villages of Béréguhé, Maboguhé and Dibléguhé (BEMADI) were interviewed in the Béréguhé public elementary school (PES), and those from the last village were interviewed in the Guéguhé public elementary school (PES).

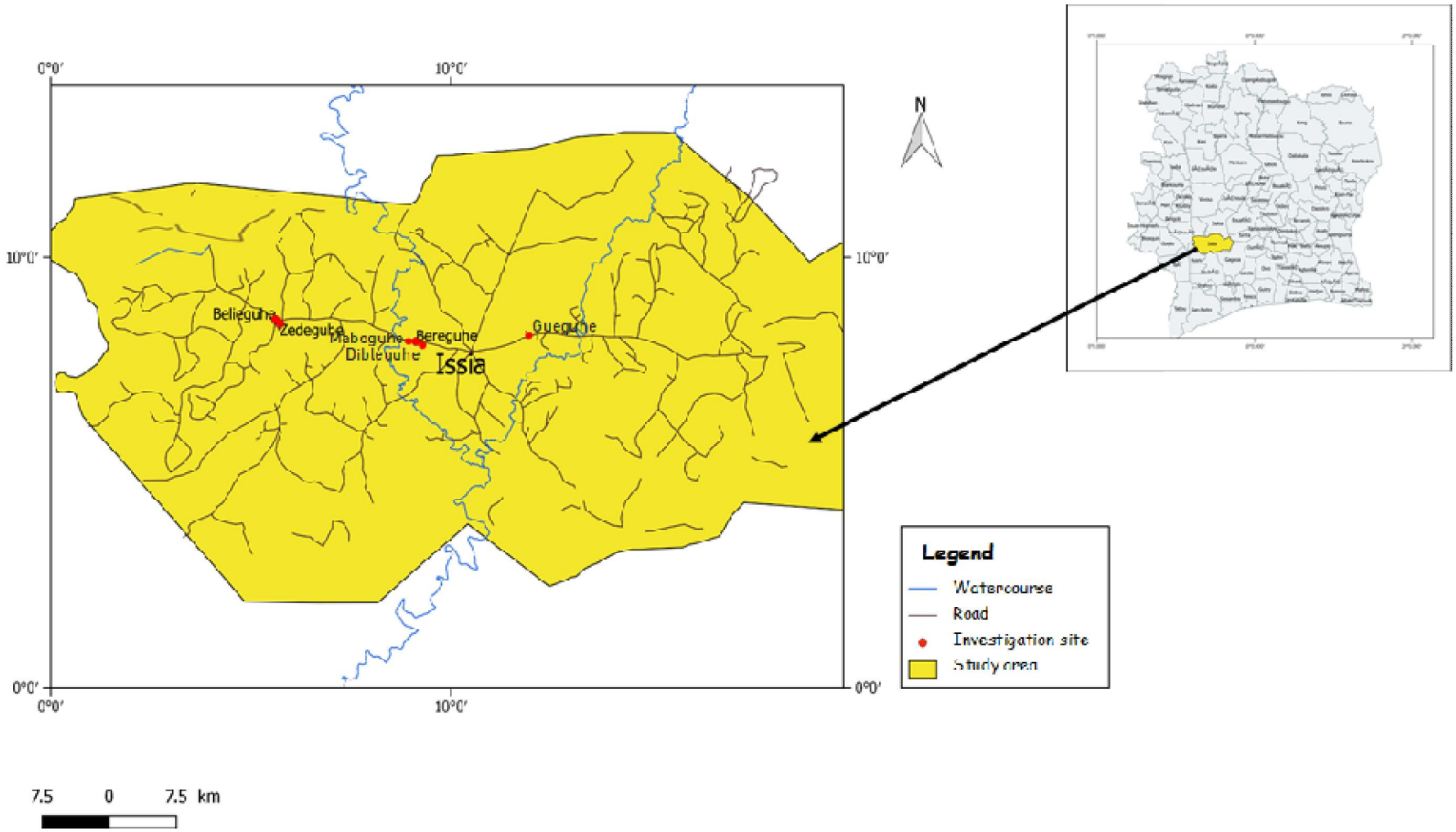

Fig 1 : Map of the study area

2.3. Study population and sampling

The survey was conducted on school children from first- to sixth-grade and aged from five to fifteen years. Schwartz's equation (1) [18], was used to determine the number of subjects needed for the study. It provided an estimate of approximately 384.16 or 385 individuals.

$$N = \frac{t^2 \times p\,(1-p)}{d^2} \qquad (1)$$

N = minimum desired sample size ;
t = 95% confidence level (standard value is 1.96) ;
p = estimated prevalence of micronutrient deficiency among school-aged children in the study area (p= 50% by default, as prevalence is unknown) ;
d = margin of error at 5% (value is 0.05).

The selection of the individuals was made through a call for applications. They were selected after an interview explaining the conditions of participation and getting informed consent from the children and parents. Four hundred and sixty (460) children took part in this study and fully answered the questions, for a response rate of 119.5%.

2.4. Inclusion criteria

All schoolchildren from the first to the sixth grade, aged five years or more, and present in the schools with a parent during the survey period were included in this study.

2.5. Exclusion criteria

In this study, schoolchildren whose parents were absent on the day of the survey, those under the age of five, and those who refused were excluded.

2.6. Data collection

A questionnaire was developed as a data collection tool with the help of KoboCollect software. This questionnaire was administered by the interviewer to the children and filled out jointly, with input from the parent, in order to gather as much information as possible on the consumption of cassava semolina (attiéké) by the children. The questionnaire has four important sections.

2.6.1. Socio-demographic characteristics

This section collected personal information about the child such as area of residence, gender, ethnicity, grade, and age.

2.6.2. Knowledge and level of consumption of cassava semolina

This part of the questionnaire consisted in collecting information on the knowledge or not of cassava semolina, the potential preferences of the children and the quantity of cassava semolina consumed per day and per child during the week preceding the survey. The estimation of the quantity of cassava semolina taken for consumption was done by the quantification method per household unit [19]. During the interview, several household

measures (plate, bowl) commonly used in the study area were filled with semolina, presented to the children for a choice and then weighed. Thus the quantity of cassava semolina consumed per day was determined according to the following equation (2) :

$$Q(g) = \frac{q \times n}{7} \qquad (2)$$

Q : The average quantity of cassava semolina consumed per day during the week ;
q : Quantity of cassava semolina taken per consumption in grams ;
n : Number of times the semolina is taken per week ;
7 : Number of days a week.

2.6.3. Cassava semolina consumption practices over the past seven days.

This part consisted of collecting data on the frequency of consumption, the origin of the consumed cassava semolina, the accompanying ingredients and the different periods of consumption during the day.

2.6.4. Availability of cassava semolina in the study area.

This aspect of the survey was identified through items such as the annual period of availability, the most available varieties, the methods and duration of storage.

2.7- Statistical exploitation of the results

The results were presented in tables and figures. The figures were produced using the 2016 version of the Excel software. The different parameters studied were expressed as numbers, percentages and averages with standard deviation. Statistical processing was performed using the version 25.0 of IBM SPSS software. Student's t-test, analysis of variance test (one-factor Anova) and correlation test were used to determine the associations between socio-demographic characteristics and the quantity of cassava semolina consumed.

3. RESULTS

3.1. School-age children's socio-demographic characteristics

In this study, the children ranged in age from five to fifteen years, with a mean of 8.4 years. There were 51.5% boys and 48.5% girls. The distribution according to area of residence is such that 43.3% of the children were from Béréguhé, Maboguhé and Dibléguhé (BEMADI); 40.0% from Béliéguhé and Zédéguhé (BZ) and 16.7% from Guéguhé. The children interviewed were from various ethnic groups with a predominance of Krou (62.2%). Regarding the school level, the results showed a high proportion of children from the Preparatory grades (53.0%). They were followed by those of the Elementary grades (31.5%) and the Middle grades (15.4%) (**Table 1**).

Table 1 : Distribution of the study population according to socio-demographic characteristics

Variables	M±SD	N (%)
Âge	8,4±2,4	
Gender		
Male		237 (51.5)
Female		223 (48.5)
Residence area		
Béréguhé, *Maboguhé* et *Dibléguhé*		199 (43.3)
Béliéguhé et *Zédéguhé*		184 (40.0)
Guéguhé		77 (16.7)
Ethnicity		
Krou		286 (62.2)
Gour		26 (5.6)
Akan		48 (10.4)
Mande		21 (4.6)
Other		79 (17.2)
School level		
Preparatory grades		244 (53.0)
Elementary grades		145 (31.5)
Middle grades		71 (15.4)

Preparatory grades *: grade 1 to 2 ; Elementary* grades *: grade 3 to 4 ; Middle* grades *: grade 5 to 6 ; Mean ± SD : Mean values ± Standard Deviation of means ; N(%) : number (percentage).*

3.2. Quantity of semolina consumed according to socio-demographic characteristics

The average quantity of cassava semolina consumed per day per child was estimated at 95.5±17 g. Results on socio-demographic characteristics showed a weak positive correlation between the quantity of cassava semolina consumed and the age of the children (r = .41; p<.01 (Figure 2). In addition, the quantity of cassava semolina consumed also varied significantly according to the children's school level (F=27.73 ; *P*=.000 ; η^2_P = .11) with statistically higher quantities among children in elementary grades (107.7g) and middle grades (113g) (Table 2).

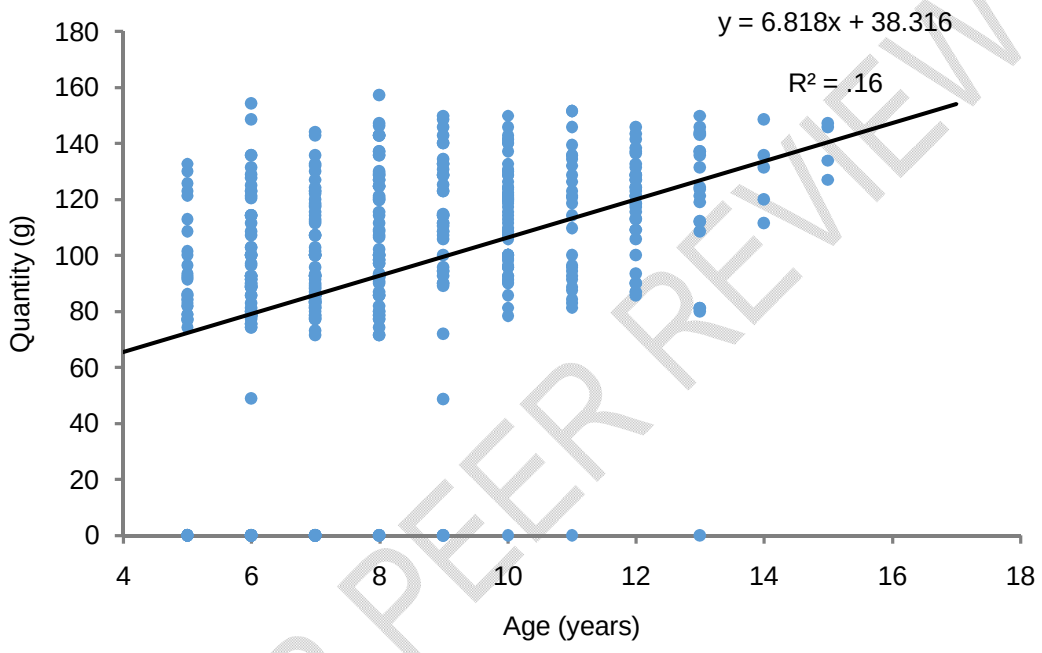

Fig 2 : Correlation between the quantity of cassava semolina consumed and the age

Table 2 : Variation in the quantity of semolina consumed according to gender, area of residence, ethnicity and school level

Variables	Quantity			
	M±SD	Statistic	*P*	η^2_P
Gender				
Male	93.5±40.6	*F* (1, 458)=1.2	.27	.00
Female	97.6±39.6			
Residence area				
Béréguhé, *Maboguhé* et *Dibléguhé*	92.7±37.9			
Béliéguhé et *Zédéguhé*	98.2±41.6	*F* (2, 457)=0.9	.40	.00
Guéguhé	96.2±42.5			
Ethnicity				
Krou	97.7±38.7			
Gour	104.1±37.6			
Akan	91.6±44.4	*F* (4, 455)=1.9	.11	.02
Mande	100.1±39.5			
Other	85.7±42.6			
School level				
Preparatory grades	83.2±43.1			
Elementary grades	107.7±31.6	*F* (2, 457)=27.7	.000	.11
Middle grades	113±30.7			

Preparatory grades : grade 1 to 2 ; Elementary grades : grade 3 to 4 ; Middle grades : grade 5 to 6 ; Mean ± SD : Mean values ± Standard Deviation of means ; F : Fisher-snedecor test ; P : p-value ; η^2_p : effect size ; criterion for significance (p<.05).

3.3. School-age children's overall level of knowledge of cassava semolina

The results showed that cassava semolina occupies an important place in the eating habits of children in all study areas. All children (100%) reported knowledge of cassava semolina. Three varieties of cassava semolina are found in these areas : the big-grain (*agbodjama*), normal-grain and small-grain varieties. However, the small-grain variety seems to be the preferred variety according to 66.9% of children, followed by the normal-grain variety (29.6%) and big-grain (3.5%) (Figure 3).

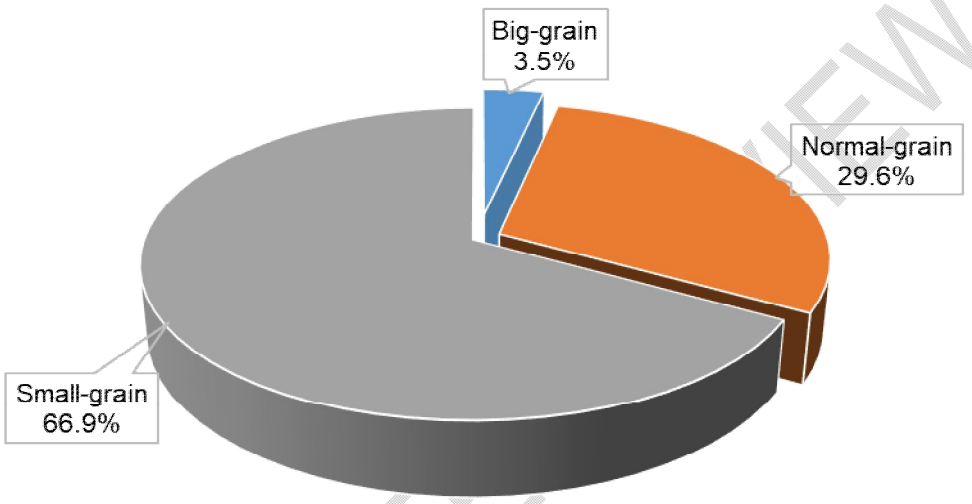

Fig 3 : Preference level of cassava semolina

3.4. Consumption practices of cassava semolina by children

About 88.5% of the population interviewed consumed cassava semolina over the last seven days prior to the survey; 35.2% of them "regularly" ate it for about four to seven days a week, and 53.3% "often" consumed it for about one to three days a week. In addition, about three quarters of the population that consumed cassava semolina (75.9%), bought it on the market. According to 77.2% of interviewed children, cassava semolina was preferably eaten at midday meal and almost always with fish (86.3%) and vegetables (79.1%) during the last seven days (**table 3).**

Table 3 : Consumption of cassava semolina during the last 7 days prior to the survey

variables	N (%)
Frequency of consumption	
Regularly (4-7 days/week)	162 (35.2)
Often (1-3 days/week)	245 (53.3)
No consumption (average of less than 1 day/week)	53 (11.5)
Origin	
Own production	32 (7.0)
Purchase	349 (75.9)
Donation	26 (5.6)
No consumption	53 (11.5)
Timing of consumption	
Breakfast	11 (2.4)
Midday meal	355 (77.2)
Evening meal	41 (8.9)
No consumption	53 (11.5)
Other ingredients	
Fish	397 (86.3)
Meat	11 (2.4)
Fried plantain (‘‘alloco’’)	74 (16.1)
Onion/tomato/pepper or other vegetables	364 (79.1)
Soup	48 (10.4)
Egg	6 (1.3)

3.5. Availability of cassava semolina in the Study Areas

With the help of the parent present, the majority of the population (95%) reported that cassava semolina was available throughout the year. However, they all (100%) said that the small grain variety was easier to find in the market, which makes it the most available variety. The storage of cassava semolina is not a commonplace practice in most of the

households from which the children come. Indeed, 68.7% of respondents said that they bought or got it for immediate consumption and only 31.3% often stored it for later consumption. In most cases, this storage is done at room temperature (29.6% of respondents), with a maximum storage period of 3 to 4 days for 18.5% of respondents and 5 to 7 days for 2.8% of them. However, for 1.7% of respondents, storage in the freezer or refrigerator allowed cassava semolina to be kept for more than a week (Table 4).

Table 4: Availability and storage practices of cassava semolina

Variables	**N (%)**
Annual period of availability	
Sunny season (December-April)	4 (0.9)
Rainy season (May-November)	19 (4.1)
Throughout the year	437 (95)
Variety easily found on the market	
Big-grain	52 (11.3)
Normal-grain	203 (44.1)
Small-grain	460 (100)
Storage method of *cassava semolina*	
Room temperature	136 (29.6)
Refrigerator / Freezer	8 (1.7)
No storage	316 (68.7)
Storage duration	
1 to 2 days	38 (8.3)
3 to 4 days	85 (18.5)
5 to 7 days	13 (2.8)
>7 days	8 (1.7)
No storage	316 (68.7)

4. Discussion

This research was conducted as a prelude to a nutritional intervention aimed at using cassava semolina (Attiéké) as a nutritional vehicle to combat micronutrient deficiencies, particularly anemia, in school-aged children in some rural communities of Côte d'Ivoire.

According to the survey results, the average quantity of cassava semolina consumed per child is 95.5 g per day. That this quantity is significantly influenced by the children's school level could because the elementary and middle grades are generally composed of older children who are likely to consume larger quantities of semolina. This result is corroborated by the correlation study, which revealed a positive correlation between the quantity of cassava semolina consumed and the child's age.

Three varieties of cassava semolina are most often found in the study area (Big grain, normal grain, small grain). The preference for the small grain variety could be justified by the fact that it is the most produced in this area. Accordingly, it is more deeply rooted in the eating habits of the inhabitants. These results differ from those of Krabi [20], whose investigations revealed a greater preference for the big grain variety by the population living in Abidjan (the economic capital). This gap in the study results would because of difference in the study areas. Indeed, Abidjan and the coastal regions of Côte d'Ivoire, constitute the original areas of cassava semolina production. The big-grained variety commonly called “prestige cassava semolina” is frequently produced with more care and mastery of processes.

The high frequency consumption of cassava semolina during the seven days before the survey, could be associated with its cheapness and its small size compared to other cassava-based products. And this could be relative to its characteristic of fast food that can be consumed both hot and cold [12]. The general consumption of cassava semolina with fish and vegetables could be justified because this food was formerly cooked and consumed only by the Adjoukrou, Ebrie, Alladjan, Avikam and Ahizi ethnic groups living in the lagoon regions of the south of Côte d'Ivoire and thus are great consumers of fishing products. This consuming habit of this food with fish has therefore spread throughout the territory of Côte d'Ivoire. This is confirmed by Assanvo Assanvo [12] and Krabi [20] whose studies were conducted in the cities of Dabou and Abidjan respectively. For these authors, cassava semolina is accompanied by vegetables and a fish-based protein source. Regarding the mode of acquisition, the survey showed that this food was mainly purchased by consumers. They certainly purchase it because of its demanding production process which requires know-how, mastery of the production process, and enough time.

Cassava semolina is mostly consumed as a midday meal, which attests to its importance in this area. That children eat this food at lunchtime could be explained by the absence of their parents. In fact, during this period of the day, most parents are swamped by their various farm and trade jobs, which take them away from home almost all day. Children are therefore obliged to buy lunch. So, they opt for cassava semolina because of its low cost.

Cassava semolina is available on the market throughout the year, according to most respondents. There are two main reasons for this. On the one hand, there is high production and availability of cassava roots. Indeed, cassava is a commodity that is produced throughout the year [21]. Grown on about 4/5 of the Ivorian national territory [22], cassava is the second most important food crop after yam [23,24]. The second reason could certainly come from the innovation of production processes with several processing technologies, including grinders, mobile or stationary motorized grinders, and double screws or mechanical cassava presses. These machines aim not only to increase productivity in a short time [25], but also to reduce the several tedious and tiring physical efforts as well. This favors frequent and steady production throughout the year. For these two main reasons, the outrageous demand for cassava semolina could be added. There are certainly no recent data on the level of consumption of this food. However, existing documentation revealed in

1995 an annual consumption estimated between 28 and 30 kg per capita [26,27]. This quantity may well have increased over the years. Thus, satisfying this high demand means constantly increasing production levels and frequencies. These results agree with those of Krabi [20], who reported that cassava semolina was produced throughout the year. And it is highly produced when the demand is very high.

According to all respondents, the small grain variety seems to be the most available on the market. This variety of cassava semolina commonly called "Garba" is purely produced for commercial reasons. Its production requires the least possible care and time and also many steps are almost not considered or quickly executed. This type of cassava semolina (Attiéké) is sold in many outlets at a cheap price and is intended for the mass clientele with relatively little financial means such as pupils/students, teenagers, unemployed people [20].

For more than half of the respondents who stored this food for later consumption, the maximum storage time varied between three and four days. These results are identical to those of Djéni [29] who stated a shelf life of three days before unwanted coloration appeared. However, in some studies, more than half of the population interviewed argued that the maximum shelf life is one week [20,29]. This difference in results could be explained by the fact that the shelf life of cassava semolina is relative to each producer's cooking methods. Indeed, according to Kouamé [30], the shelf life of cassava semolina is determined by the cooking method and hygienic practices. The deterioration of this food is caused by its wetness, the storage conditions and micro-organisms that lead to changes in taste, color and increase in pH.

5. CONCLUSION

This survey conclouded that cassava semolina played a major role in the diet of children in all six villages surveyed, and the preferred variety was small-grain cassava semolina. It also revealed that children very often bought cassava semolina and consumed it most often as a midday meal with fish and vegetables. In addition, this food is available on the market throughout the year. Still, its shelf life still requires improvements. Finally, the survey showed that the quantity of cassava semolina consumed increased with the age of the children.

These results thus conclouded the possibility of using cassava semolina as a nutritional vehicle in programs to combat malnutrition. This food could therefore be fortified for the universal school lunch program in Côte d'Ivoire. However, dehydration techniques for long shelf life and education for canteen staff for the adoption of this food are needed.

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COMPETING INTERESTS

Authors have declared that no competing interests exist

AUTEURS AUTHORS' CONTRIBUTIONS

Author DAF designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author GGA helped design the study and write the first draft of the manuscript. Author BMS contributed to the the literature searches. All authors read and approved the final manuscript.

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REFERENCES

1. Keats EC, Neufeld LM, Garrett DS, Mbuya MNN, Bhutta ZA. Improved micronutrient status and health outcomes in low- and middle-income countries following large-scale fortification: evidence from a systematic review and meta-analysis. Am. J. Clin. Nutr. 2019;109:1696–1708.

2. Failla ML. Trace elements and host defense: recent advances and persistent challenges. Nutrition Journal. 2003;133:1443S-1447S. French.

3. Strang B. Investing in the future, a united call to action to overcome vitamin and mineral deficiencies. Global report. 2009; 52 p. French.

4. Balla MD, Chowdhury J. Current situation of micronutrient deficiencies in west africa. 2015 ; 10-15.

5. Agbo E, Mahyao A, Konan AD, Coulibaly L, Kouassi A, Kehlenbeck, and al. Production, consumption and nutrition survey in a cocoa farming area in the Nawa region. Postponement. ICRAF. Abidjan. 2014. French.

6. Savy M. Dietary diversity indices: measurement and use among women of reproductive age in Burkina Faso. Doctoral thesis from the University of Paris 6. 2006. French.

7. Das JK, Salam RA, Kumar R, Bhutta ZA. Micronutrient fortification of food and its impact on woman and child health: a systematic review. Systematic Reviews. 2013;2(1):1-24.

8. Macharia-Mutie CW, Omusundi AM, Mwai JM, Mwangi AM, Brouwer ID. Simulation of the effect of maize porridge fortified with grain amaranth or micronutrient powder containing NaFeEDTA on iron intake and status in Kenyan children. Public HealthNutrition. 2013;16(9):1605-1613.

9. Hackl LS, Abizari AR, Speich C, Zungbey-Garti H, Cercamondi CI, Zeder. Micronutrient-fortified rice can be a significant source of dietary bioavailable iron in schoolchildren from rural Ghana. Science Advances. 2019;5(3): eaau0790.

10. OkigboBN. Nutritional implications of projects giving high priority to the production of staples of low nutritive quality. In the case for cassava (Manihot esculenta, Crantz) in the humid tropics of West Africa. Food and Nutrition Bulletin. 1980;2(4):1-10.

11. Spencer DSC, Ezedinma C. Cassava cultivation in sub-Saharan Africa. In Hershey CH, editor. Achieving sustainable cultivation of cassava: Cultivation techniques. 2017;1:123-148.

12. Assanvo JB, Agbo GN, Behi YEN, Coulin P, Farah Z. Microflora of traditional starter made from cassava for attiéké production in Dabou (Ivory Coast). Food Control. 2006;17:37-41.

13. Barussaud S, Kouassi VA. Employment and Income in the Cassava Value Chain in Côte d'Ivoire. International Labor Organization. STRENGTHEN Publication Series, Working Paper. 2019;9. French.

14. UN-Habitat. Ivory Coast: Issia Urban Profile, United Nations Human Settlements Programme. 2012; 22p. French.

15. Koffie-Bikpo C Y, Kra KS. The Haut-Sassandra region in the distribution of agricultural food products. Review of Tropical Geography and Environment. 2013;2:96-103. French.

16. Ministry of Health and Public Hygiene. Annual Report on the Health Situation. 2016; 377p. French.

17. National Institute of Statistics. General population and housing census: RGPH-2021, Global results. 2021. French

18. SCHWARTZ D. Statistical methods for the use of physicians and biologists. edition Flammarion Médecins Sciences; 1969. French.

19. Gruson E, Romon M. Methodology of dietary surveys. Cah., Nutr. Diet. 2007; 42(5): 276-284. French.

20. Krabi ER, Assamoi AA, Ehon AF, Brehima D, Niamké LS, Thonart P. Production of attiéké (couscous made from fermented cassava) in the city of Abidjan. European Scientific Journal. 2015;15(11):277-294. French.

21. Yao AK, Koffi DM, Blei SH, Irié ZB, Niamke SL. Biochemical and organoleptic properties of three traditional Ivorian dishes (attiéké, placali, attoukpou) based on native cassava granules. Int. J. Biol. Chem. Science. 2015;9(3):341-1353. DOI: http://dx.doi.org/10.4314/ijbcs.v9i3.19. French.

22. N'Zué B, Zohouri PG, Sangaré A. Agronomic performance of some cassava varieties from three agro-climatic zones of Côte d'Ivoire. Agron. Afr. 2004;16:1-7. French.

23. Ducroquet H. Ivorian agriculture under the microscope (1). Professed. agr. 2002;3:10-12. French.

24. Anonymous. Ministry of Agriculture : regional consultation on the food and nutrition situation in the Sahel and West Africa. Ivory Coast report. 2008; 21p. French.

25. Amani G, Nindjin C, N'Zué B, Tschannen A, Aka D. Potentialities for the transformation of cassava (Manihot esculenta Crantz) in West Africa. In UAA-CSRS-CNRA-I2T, editors. Proceedings of the international workshop. Abidjan, Ivory Coast. 2007; 341 p. French.

26. Trèche S. Importance of cassava in human nutrition in different regions of the world. In: Aglor ET, Brauman A, Griffon D, Trèche S, editors. Food processing of cassava. ORSTOM: Paris; 1995. French.

27. Giraud E, Brauliman A, Keleke S, Gosselin L, Raimmult M. Cassava fermentation control for a m better gari: use of a Lactobacillus plantarum starter with linamarase and amylase activity. In: Aglor ET, Brauman A, Griffon D, Trèche S, editors. Food processing of cassava. ORSTOM: Paris; 1995.French.

28. Djeni NT, N'Guessan KF, Toka DM, Kouame KA, Djé MK. Quality of Attiéké (a fermented cassava product) from the three main processing zones in Côte d'Ivoire. Food Research International. 2011;44:410-416.

29. Adaye AA. Production and conservation of cassava semolina (Attiéké), in the town of Bouake (Ivory Coast). Space, Territories, Societies and Health Review. 2020;3(5):93-108. French.

30. Kouame AK, Djéni TN, N'Guessan FK, Djé MK. Postprocessing microflora of commercial attieke (a fermented cassava product) produced in the south of Côte d'Ivoire. Letters in Applied Microbiology. 2012; 56: 44-50.