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CONTRIBUTION OF LOCAL AGROBIODIVERSITY TO COMPLEMENTARY FOODS FOR 6 TO 23 MONTHS OLD CHILDREN IN SOUTHERN RURAL BENIN

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ABSTRACT

In rural Benin, malnutrition, especially micronutrient deficiencies, contrasts with a rich agrobiodiversity that abounds in cultivated or wild foods that are potential sources of micronutrients. This paradox leads us to examine the role of local agrobiodiversity in the diet of children living in two agroecological zones of southern Benin. This study involved 1,263 children aged 6-23 months from 17 randomly selected villages in Southern Benin. A multiple-pass 24-h recall method on two non-consecutive days with the estimation of the consumed portions was used to collect dietary intake data. Semi-structured questionnaires were used to collect socioeconomic and demographic data to explore factors driving agrobiodiversity food consumption, especially wild foods. Non-parametric analyses based on gamma distribution were performed to establish the effect of wild food consumption on vitamin A, calcium, iron, and zinc intakes. Conditional inference tree-classification models were performed to identify factors driving wild food consumption. Among a total of 48 local foods that were reported as consumed by children, 11 were from wild species. The contributions of total local agrobiodiversity to nutrient intake of complementary foods was between 49% (calcium) and 98% (vitamin A). Cultivated species contributed to local agrobiodiversity foods for 57% (calcium) and 96 % (zinc). The semi-domesticated species have a contribution of between 2% (zinc) and 35% (calcium) to nutrient intake. Wild species contribution to nutrient intake was between 1% (zinc) and 9% for vitamin C. Wild foods consumption correlated significantly and positively with calcium and vitamin A intakes among children. Socio-linguistic factors such as ethnicity and religion of the household head were determinants of wild food consumption. These findings suggest that sensitization on the nutritional importance of the wild foods including socio-linguistic factors may be necessary to promote wild foods' consumption. This could be a good strategy to promote healthy diets in local communities.

Key words: agroecological zone**,** micronutrients, local biodiversity, wild food, healthy diets, Benin

INTRODUCTION

The world is facing a triple burden of malnutrition characterized by the coexistence of undernutrition (wasting), hidden hunger (essential micronutrient deficiencies), and overweight. This threatens the survival, growth, and development of children and nations. The latest global estimates indicate that 6.7% of children under 5 are wasted, 22% are stunted while 5.7% are overweight [1]. These patterns are critical in the African region where 30.7% of children under 5 are stunted, while the number of overweight children is increasing (5.3%) [1]. The latest Multiple Indicator Cluster Survey (MICS) and Demographic and Health Survey (DHS) in Benin demonstrate that barely one in every four children (25.3%) meet the minimal dietary diversity indicating the monotony of the diet [2] and prevalence of stunting among children under five is still very high (32%) [3].

Child malnutrition in its all forms has multiple and intertwined immediate and underlying causes among which inadequate maternal nutrition, consumption of micronutrient poor diets in infancy and early childhood, and changing food systems that lead to increased consumption of cheap sugary, and unhealthy foods that are high in salt, sugar, and fat, but poor in essential nutrients [4]. The latter are food-related and imply low food availability and accessibility or a poor supply of micronutrient-rich foods. Yet, Benin, a coastal country in West Africa with favorable rainfall patterns, disposes of a rich agrobiodiversity that is the foundation of all food systems and key to providing children with nutritious, safe, affordable, and sustainable diets [5].

Local agrobiodiversity (LABDF) refers to food sources that are grown locally and/or harvested from the wild within a given study area. In several regions of sub-Saharan Africa, local agrobiodiversity plays an important role in supplementing staple foods [6]. Both domesticated (cultivated) species and wild edible plants contribute to human nutrition in several ways, including providing a rich source of nutrients and contributing to dietary diversity and quality [7]. Local animal sourced foods, including wild species (vertebrates and invertebrates), provide highly bioavailable nutrients such as iron, zinc, and vitamin B12; as well as proteins and fats. Local foods also offer a wide diversity of leafy vegetables, fruits, nuts, and others, which are sources of vitamin A, iron, folic acid, niacin, and calcium [7]. Promotion of local foods is, therefore, of interest aiming at reducing the gaps between nutrient requirements and nutrient intakes [8]. Other authors emphasized that forest foods, including tree, herb, fungus, and animal products, contribute in several ways to improved food security by providing immediate access to affordable and often highly nourishing foods [9]. Despite these nutritional benefits, studies show that the substitution of local foods, especially wild foods, by modern foods like processed foods, cookies, and sweets is part of the nutritional transition that many African countries are undergoing, and this contributes highly to several public health problems [8]. Bharucha and Pretty [8] estimate that the reliance on purchased foods or cultivated foods will continue to grow in Africa and that wild foods will be increasingly marginalized, while the use of wild edible species is a key adaptation strategy for several households, in response to shocks such as food crop failure, drought or flooding, loss of income or any other difficult situation.

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Globally, several studies have provided evidence on specific contributions of wild edible species to food and nutritional security in several agroecosystems [6, 10]. However, local agrobiodiversity use remains underexplored especially among rural populations and detailed data on the actual dietary contribution of local agrobiodiversity products to rural population feeding are still lacking despite their great potential to improve dietary quality [11].

In African countries like Benin, meals served to children from 6 to 23 months are mostly staple foods based with low sources of essential micronutrients [2] leading to micronutrient deficiencies. Therefore, providing information on how to enrich family diets by using ingredients from local food sources rich in micronutrients can contribute to improving complementary diet quality [12].

On the other hand, equally in Benin, Achigan-Dako and colleagues documented 245 different vegetable species of which 176 were wild and only 47 were cultivated. The remaining 22 of these resources were reported both as cultivated and wild, depending on the village [13]. Another study by Dansi *et al.* [9], using participatory rural appraisal surveys in three regions or agro-ecological zones of Benin, documented 187 edible plant species of which 47 were cultivated and 140 were gathered from the wild [9].

The present study aimed to assess the contributions of local agrobiodiversity to the dietary intake of children aged 6 to 23 months in two agroecological zones of southern rural Benin. The purpose of this study was to describe the importance and potential of local agrobiodiversity to improve the diet of children in rural settings.

MATERIALS AND METHODS

Study area

The study was conducted in the department of Mono, located in southwestern Benin. This part of Benin is known for its high rate of stunting (29%) among children under five [3], which is in contrast with the richness of the local food diversity [13]. Within Mono department, two communities - *Bopa* and *Houéyogbé*-belonging respectively to agroecological zones 8 and 6, characterized by bar ground and fisheries respectively, were selected due to their high prevalence of food insecurity: 40.5% and 34.1 % in *Bopa* and *Houéyogbé*, respectively [14].

Sampling

A multistage sampling method was used to select the study participants. *Bopa* and *Houéyogbé's* communes within Mono Department were selected purposively due to their highest rates of food insecurity compared to other communes in the Mono department. Using the Schwartz formula [15], the theoretical sample size calculated was 1182 children aged 6 to 23 months, which was extended to 1300 by 10% increase to consider potential drop out cases. The number of children to be selected in each commune was obtained by dividing the sample proportionally to the population of children aged 6 to 23 months in the two communes. The proportions obtained were 47% for *Bopa* and 53% for *Houéyogbé* [14]. This yielded 611 and 689 children aged 6 to 23 months in *Bopa* and *Houéyogbé*, respectively. For statistical analysis efficiency, we set a minimum of 35 children to be sampled from each age group: 6 to 11, and 12 to 23 months, in each village. With a small margin, this meant 80 children aged 6 to 23 months to be sampled per village. Hence, 17 villages (8 in *Bopa* and 9 in *Houéyogbé*) were randomly selected. Finally, after accounting for drop outs and field realities, 1263 children were randomly interviewed in the two communities proportionally to the number of children counted in each of the 17 selected villages. This was well over the 1182 children from the theoretical sample size calculation.

Ethical clearance for this study was obtained from the National Ethics Committee for Scientific Research (N°45/MS/DC/SGM/DFR/CNERS/SA). Study objectives as well as the confidentiality of data to be collected were clearly explained to the participants and they were allowed to ask questions for clarification. Written informed consent was obtained from the primary caregivers (usually mothers) willing to participate, under the agreement of the child's father.

Data collection procedures

For the data collection, 34 experienced interviewers having at least a Bachelor's degree in the fields of agronomy, nutrition, or sociology, and proficient in the languages spoken in the study area, were selected and trained. The data used in this paper were collected from October to December 2013, corresponding to the plenty season or period considered with good staple food availability (cereals, roots and tubers harvesting period) in the study area.

Demographic and socioeconomic data

Semi-structured interviews were carried out with the heads of households and mothers of surveyed children or caregivers. Demographic information such as sex, main occupation, educational level, ethnic group, religion, salary status, the marital status of heads and mothers of surveyed children were collected. The socioeconomic data included economic vulnerability of household and household size.

24-hour dietary recall

Dietary data were collected using a quantitative 24-hour dietary intake recall repeated twice on non-consecutive days following the methodology described by Gibson and Ferguson [16]. Mothers or primary caregivers, responsible for food preparation and feeding the child the day before, were asked to describe all the foods and beverages consumed including those eaten away from home by the children during the day previous to the interview. The quantities cooked and eaten were estimated using household measures such as spoons, bowls, water, sponge, and market prices. Weights of ingredients consumed were estimated in raw forms and expressed as proportions of the total weights of food prepared to estimate the exact quantities of the food or ingredients consumed by the child. For foods consumed or prepared outside the home, standard recipes were calculated.

To convert the quantities of foods or ingredients consumed into energy and nutrients intakes, Lucille software was used [17]. For this purpose, a food composition table of the area was compiled based primarily on the Malian FCT [18]. Other food composition tables were used when foods or nutrients were missing. These included the West African FCTs [19, 20], the USDA table [21], the Tanzanian FCT [22], the Uganda FCT [23], the *Fichier canadien pour les éléments nutritifs* [24], and the table of selected foods from West Africa [25]. The compiled FCT was uploaded in Lucille software. The West African table of nutrient retention factors was used to correct values for nutrient retention. The nutrient intakes from the two recalls were converted to usual intakes using the Multiple Source Method (MSN) program [26].

Processing of intake data

Categorization of foods consumed by children

Local agrobiodiversity foods (LABDFs) were identified from all complementary foods (CFs) consumed by children. LABDFs were further divided into three sub-categories: cultivated/domesticated species (LABDF_Cult), semi-cultivated species or undergoing domestication (LABDF_Semi) and, wild plant and animal species (LABDF_Wild) irrespective of their origin, which are not cultivated or raised, but collected in the natural state. The categorizations were based on an ethnobiological survey that listed and classified all edible species available in the study area (Termote *et al*. unpublished project report) [27]. Foods from the 24-hour recall data were also categorized into 10 different food groups: cereals; roots and tubers; pulses and nuts; meat; fish and seafood; leafy vegetables; fruits; other vegetables; eggs; other foods. The 7 food groups that are recommended by WHO for infants and young children were not considered here because the purpose was to capture the consumption of detailed food groups.

Data management and statistical analysis

The contribution of local agrobiodiversity (LABDFs) to the children's diet was determined by the ratio of dietary intakes expressed as a percentage. For example, the contribution of LABDF_Wild to the intake of local agrobiodiversity foods (LABDFs):

$$\text{LABDF\_Wild contribution to LABDFs (\%)} = \frac{\text{Energy or nutrient intake of LABDF\_Wild}}{\text{Energy or nutrient intake of LABDFs}} * 100$$

Associations between the consumption of wild species and micronutrient intake were tested using General Linear Models (GLMs). To select the factors that should be controlled for in the GLM models, we first tested bivariate associations between micronutrient intakes and each factor (agroecological zone, sex, age, breastfeeding status and energy intake from complementary foods), and then a step-by-step selection procedure was used to retain only the significant associations. Only the models based on the gamma distribution were well-adjusted (Chi-2 test on the residual deviance) and were retained. A Chi-squared test was used to characterize wild foods consumers compared to non-consumers of wild foods. To identify factors that most influenced wild food consumption, conditional inference tree-based classification models were performed. R statistical free software was used for all statistical analyses with the significance level fixed at 5% [28].

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RESULTS AND DISCUSSION

Basic characteristics of the sample

Men (94%) headed the large majority of households, and almost all (98%) HHs were economically vulnerable. On average, the household heads were 35.7±9.0 years old (Table1). *Sahoué* (84%) was by far the dominant ethnic among the surveyed population, followed by *Kotafon* (8%) and *Adja* (3%).
Agricultural crop production was the main income source of the households, and only 8% of them had off-farm employment. Almost half of the household heads had not attended school. The mothers were 28.3±6.6 years on average. Two third of the mothers did not receive any school education and only 2% of them had paid employment. The main income source of the mothers was small business (44%), crop production (31%), and animal husbandry (18%). More than 50% of the surveyed children were boys and 63% were aged between 12 to 23 months.

Consumption of food groups and local agrobiodiversity foods (LABDFs)

The 24h dietary data revealed that 48 foods were consumed by children (Table 2). *Zea mays* L. (Maize) was the most important food consumed (91% of children) within the cereals food group. *Capsicum spp* (Chili pepper; 78%), *Elaeis guineeinsis* Jacq. (palm nut; 57%), *Solanum lycopersicum* (tomato; 38%), *Manihot esculenta* Crantz (cassava; 24%), and *Vigna unguiculata* L. (cowpea; 21%) were also well consumed by children. However, *Macrobrachium dux* Lenz*,* (shrimps), *Adansonia digitata* L. (baobab), *Fungi spp*. (mushrooms*), Talinum triangulare* Jack. (ceylon spinach), *Mangifera indica* L.(mango) and *Vitex doniana* Sweet (savannah plum), which are good sources of proteins or micronutrients, were consumed by less than 1% of the surveyed children. Likewise, infants and young children rarely consumed meats and eggs. The most consumed leafy vegetable was *Corchorus olitorius* L. (jute mallow), consumed by about a quarter of the children. As for the fruits, *Citrus sinensis* L. (orange) and *Musa spp.* (desert bananas) were consumed by only 3% and 1.5% of children, respectively. The average portion size of the consumers was 75 g for maize, 57 g for *Dioscorea spp.* (yam) and 88g for *Cocos nucifera* (coconut). Among fish and seafood, the average portion of *Silurus glanis* (black silurus) was 12 g per child per day. The average portion sizes of *Ipomea aquatica* Forssk (water spinach) and *Ananas comosus* (Pineapple) were respectively 43.5g and 121 g. The *Gallus gallus domesticus* Linnaeus (Egg) portion size consumed was 31 g on average.

This food pattern clearly shows the monotonous diet of the children that is based on cereal (maize) with low consumption of leafy vegetables and fruits. This was becoming as norm in some West-African countries including Nigeria where complementary foods are based mainly on cereals, and are low in micronutrient-dense foods like meet, egg, seafoods, leafy vegetables and fruits [29].

Local agrobiodiversity foods contribution to total energy and nutrient intakes from complementary foods

Local agrobiodiversity foods (LABDFs) appear to be the most important source of micronutrients intake by the surveyed children (Figure 1). LABDFs contributed 97.9% of vitamin A, 92.3% of vitamin C, 85.3% of folate, 82.2% of iron, 62.3% of energy,

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and 55% of proteins intake. Local foods contributed less than 50% to the calcium intake.

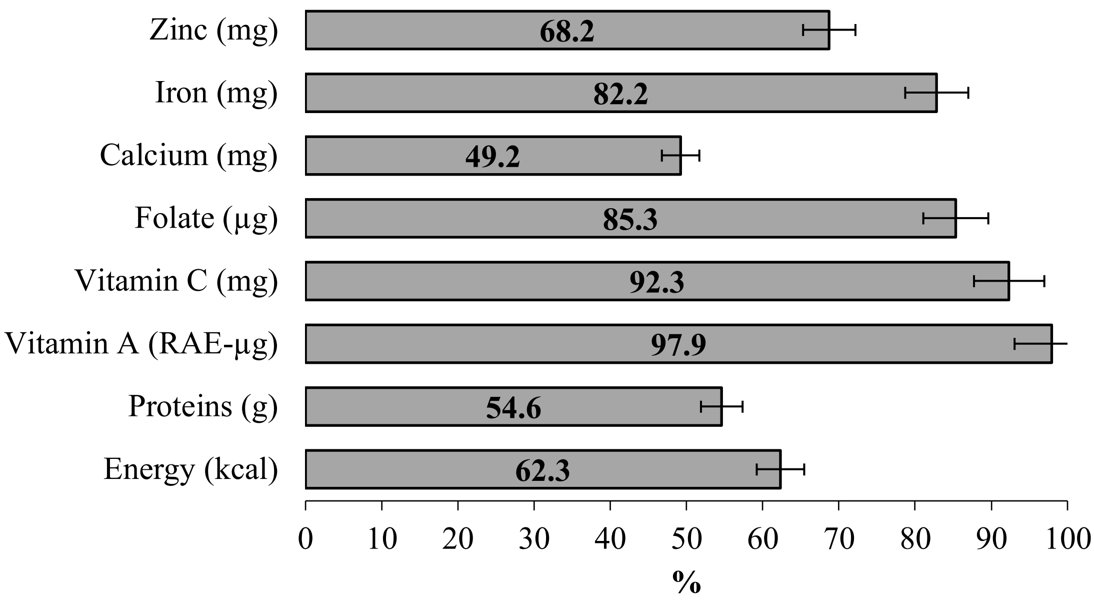

Figure 1: Local agrobiodiversity foods contribution (%) with error bars at 5% to energy and nutrient intakes from complementary foods among children aged 6-23 months

Relative contribution of local agrobiodiversity foods from wild, semi-domesticated and domesticated sources to energy and nutrient intakes

More than 90% of energy, proteins, zinc, iron, and vitamin A intakes from LABDFs came from cultivated or domesticated species. Local food sources contributing to calcium intake were more varied since 57% came from LABDF_Cult, 35% came from semi-cultivated LABDF_Semi, and 8% from LABDF_Wild. A similar pattern was observed for vitamin C intakes. Overall LABDF_Wild had very low contributions to energy and nutrient intakes from LABDFs despite their high nutritional potentiality (Figure 2).

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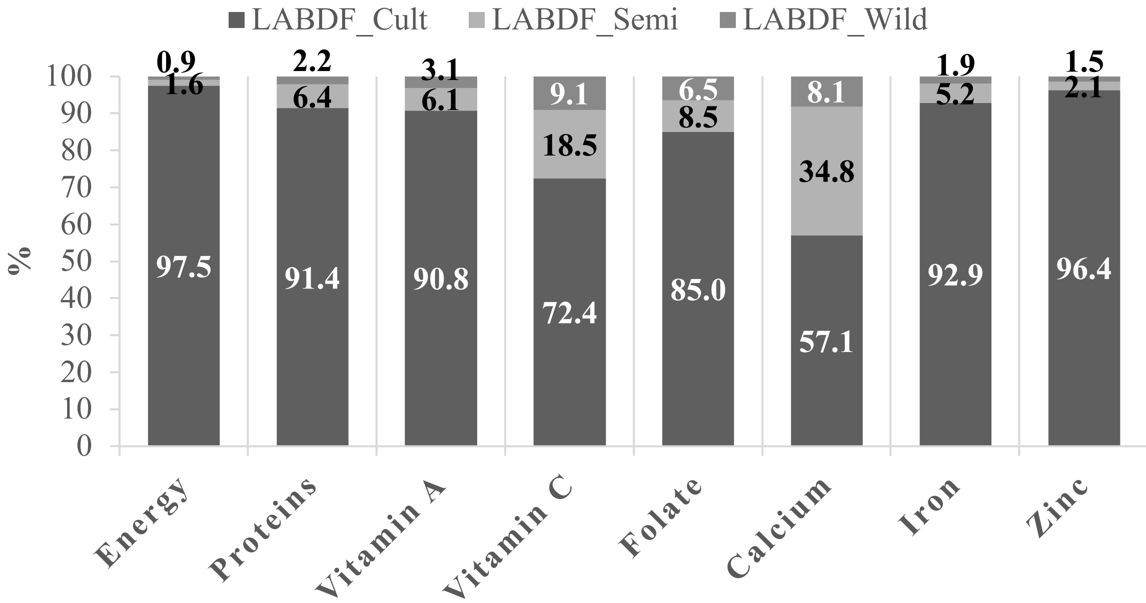

Figure 2: Share of wild, semi-domesticated and cultivated sources to energy and nutrients intakes from local agrobiodiversity foods amongst 6-23-month-old children (n=1183)

Local agrobiodiversity foods' contributions to essential nutrient intakes and energy ranged from 49% (calcium) to 98% (vitamin A) (Figure 1). This implies that these foods contributed to a significant share of energy, proteins, vitamin A, vitamin C, folate, calcium, iron, and zinc intakes from complementary foods. The relatively low contribution of LABDFs to calcium intake from CFs could be partly because calcium came majorly from non-local foods especially from fried small fish. When looking at the different categories of LABDFs, cultivated or domesticated foods had very large contributions to the nutritional intakes of LABDFs, with 57% for calcium and 96% for zinc. The semi-domesticated food resources had low contributions to nutritional intakes, except for calcium (35%). Wild foods contributed marginally to LABDFs with a maximum of 9% for vitamin C. The period of relative food abundance in which data collection took place could explain the over-representation of consumption of cultivated or domesticated food resources compared to wild foods during that specific period. The results could also be explained by a lack of knowledge about the nutritional potential of wild food species in the diet of rural populations since these resources were not consumed much (11 out of a total of 48 foods identified in he 24h recall were wild foods). Yet, the ethnobiological survey carried out in the same area, indicated that of the 298 edible species listed in total, 174 were wild species. We note however that, the 24h-recall only provides a snapshot of the diet during a period of relative abundance of staple foods, while the ethnobiological surveys captured resources available throughout the year. Nonetheless, the very low use of wild species, could further be explained in various ways. Wild foods especially fruits gathering is generally interpreted as being indicative of famine and their consumption evokes indignity and social stigma [30]. Additionally, Pawera and colleagues highlighted that the barriers to consuming wild

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foods were low availability, time constraints, and limited knowledge of their nutritional value [31].

Dietary habits and cultural perceptions could also explain these results, since rural populations, due to taboos, perceive wild foods as culturally not acceptable [31]. This is in line with findings from rural Ethiopia, where non-domesticated fruits and vegetables were rarely consumed by children because of cultural attitudes [30]. Hence, the low consumption of wild foods by infants and young children explained their low contribution to nutritional intakes, as shown by others [32]. A study conducted in rural South Africa concluded that not all known wild food species were consumed and the little that was consumed was in small quantities [11]. Nevertheless, people's high dependence on cereal-based foods remains a major part of the explanation [30].

Several studies have addressed the contribution of wild foods to diets, but few have focused on quantitative methods. In a study conducted by Boedecker and colleagues on the "Contribution of non-wood forest (underutilized) plants to the nutritional intakes of women living around the Lama Forest" in Benin, results showed low contributions of wild edible plants to the nutritional intakes of their diets ranging from 0.1 % (zinc) to 5% (iron) [33]. Another study carried out among women from the Mekong Delta in Vietnam showed important contributions of wild vegetables to micronutrient intakes ranging from about 5% for energy to 100% for vitamin A [34]. Likewise, in rural Tanzania, it has been shown that wild foods from farms and forests made a significant contribution to children's diets, ranging from 2.5% for energy to 30.5% for vitamin A intake [35]. Wild foods also contributed to intakes of vitamin C (21.7%), iron (20%), calcium (16%), folate (13.3%), and zinc (5.4%), which is much higher than the wild food contributions found in this study. The study in Tanzania was carried out during the rainy season when there is high availability and accessibility of wild foods, especially fruits and leafy vegetables, while our study took place in the post-harvest period with high availability of cereals, roots, and tubers.

Adjusted relationship between usual daily intakes from complementary foods (CFs) and wild foods (LABDF_wild) consumption

The results of the gamma regressions adjusted for micronutrient intakes, age, sex, breastfeeding status of children, agroecological zone, and energy intake of children are presented in Table 3. We found a significant and positive relationship between daily vitamin A and calcium intakes and LABDF_Wild consumption. For children who had consumed LABDF_Wild, there was on average an increase of 97% (68% - 126%; P = 0.000) and 49% (28%-70%; P = 0.000) of vitamin A and calcium intakes respectively. The effect of LABDF_Wild consumption on vitamin A and calcium intakes decreased with energy intake and was higher in AEZ 8 than in AEZ 6.

Despite the low observed contributions of wild foods to the nutrient intakes from local foods in this study, their consumption positively influences micronutrient intakes of complementary foods. Indeed, we found that, after adjustment for energy, age, and sex of children, their breastfeeding status, and their AEZs of origin, children who consumed wild foods had higher intakes of vitamin A, calcium, and iron than children who did not consume wild foods. The study from DR Congo, based on the biodiverse environment contribution to women's diet revealed that the wild food consumers had significantly higher intakes of vitamin A, vitamin C, vitamin B6, and calcium (all nutrients adjusted for energy intake) compared to non-WEP consumers [36]. Boedecker and colleagues' study, targeted women living in the Lama forest in Benin, findings suggested that only a significant difference for copper (adjustment for energy intake) and vitamin C intakes (without adjustment for energy intake) were higher among WEP consumers than in non-WEP consumers [33].

Factors associated with children's consumption of wild foods (LABDF_Wild)
Drivers of LABDF_Wild consumption by children included ethnicity of the household head, child sex, and religion of the household head (Figure 3). Households with heads from the *Fon, Kotafon,* and *Mina* ethnic groups had a relatively higher proportion of children consuming wild foods compared to those with heads from *Adja*, *Sahoué,* and other ethnicities such as *Aïzo, Pedah* (P=0.002). Among the latter, male children consumed more wild edible species than female children. Of these male children, those from households where the head did not practice any religion consumed more wild foods than those from households where the head was animist or Christian (P=0.001). This study shows several factors that correlated with wild species consumption. These included the ethnicity and religion of the household's heads, as well as the sex of children. A study conducted in the north of Benin revealed that ethnicity influenced Non-Timber Forest Products (NTFPs) consumption. The *Baatonou* ethnic group exploited more NTFPs than *Fulani*; so did the older household heads compared to younger ones [37]. However, we could not compare these findings to the participants of this study due to the different ethnical backgrouds that characterize the study areas. Other authors have found that agricultural factors such as household crop diversity and hours spent on the farm were associated with wild food use [35]. In Cameroun, the polygamy status, age of respondents, and the length of stay in forest areas were positively associated with wild food consumption [38]. On the other hand, the most frequent reasons for the underuse of traditional food species include, local perceptions of wild foods as being foods for the poor and loss of traditional knowledge [8, 33]. Food preferences (both personal and household), taste, smell of some of the vegetables, and their unavailability/ seasonality are other reasons that have been described for the underutilization of wild foods [39].

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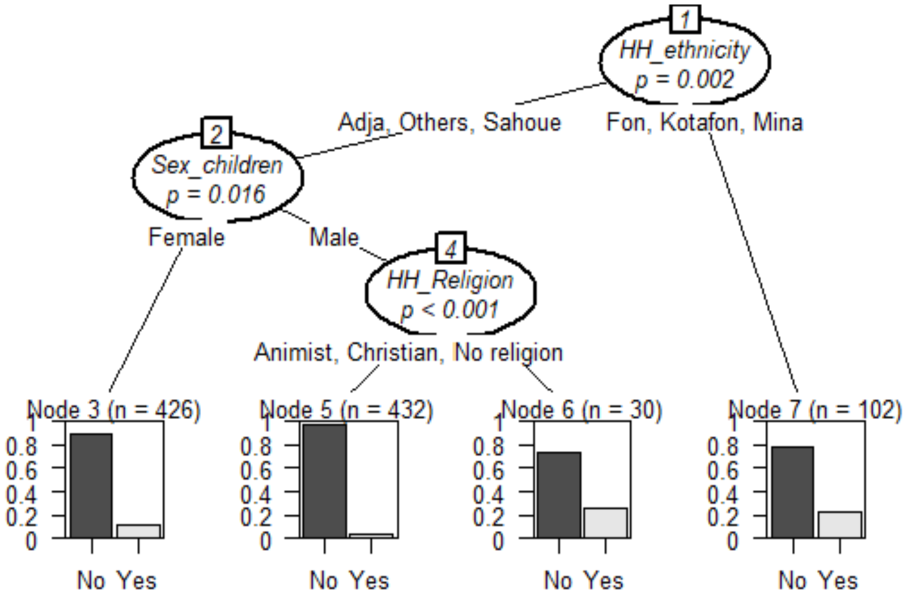

Values here are the percentages of LABDF_Wild consumption or not, LABDF_Wild consumption_No (**No**), LABDF_Wild consumption_Yes (**Yes**); HH= head of household

Figure 3: Conditional inference tree showing factors associated with LABDF_Wild consumption among 6-23-month-old children

Limitation of study

The major limitation of this study is the non-availability of a food composition table for Benin. The use of Mali's food composition table as the basis of our compiled food composition table constitutes a limitation because the food composition data have significant differences related to the agro-ecological zone, seasonality and, genetic diversity [40]. The development of composition tables is essential for the correct interpretation of the nutritional contribution of the food consumed. Thus, we recommend that a food composition table be developed in Benin for at least the common foods. The strength of this study is that we performed two recalls on non-consecutive days, which is appropriate to correct for intra-individual variance and calculate the usual nutrient intakes among children. However, to better capture all aspects of children's food consumption, the 24-hour recalls would cover not only the season of food abundance but also the lean season.

CONCLUSION

Although local agrobiodiversity considerably contributes to energy and nutrients intakes in the diet of small children in southern Benin, wild foods only marginally contribute. However, wild food consumption has a positive effect on the micronutrient intakes of children. Therefore, local communities, NGOs, and policymakers must put more effort to promote them to improve the diets of small children. One way to promote wild foods would be to organize awareness sessions for local populations with key messages on the nutritional importance of wild foods. For more impact, these key messages should also take into account the socio-cultural factors, particularly the *ethnicity* and *religion of the household's head*, and the *gender of children* living in the household. Investing in the domestication of wild food species might be a better pathway for conservation and sustainability of micronutrient deficiency control strategies, focusing on the use of local foods, especially wild ones.

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Table 1: Socio-economic and demographic characteristics of the surveyed sample

Characteristics	n	%	Mean ± SD
Household			
Sex of the household head (N=1263)			
Male	1189	94.1	
Female	74	5.9	
Age of the household head (Years) (N=1248)			35.7±9.0
Ethnicity of the household head (N=1164)			
Adja	35	3.0	
Fon	21	1.8	
Mina	20	1.7	
Kotafon	93	8.0	
Sahoué	972	83.5	
Others	23	1.9	
Type of household (N=1210)			
Monogamic	779	64.4	
Polygamic	431	35.6	
Economic vulnerability (N=1257)			
Vulnerable	30	2.4	
Non-vulnerable	1227	97.6	
Main income sources of the household head (N=1263)			
Salary	98	7.8	
Plant production	544	43.1	
Breeding	281	22.2	
Collectors/Hunting/Fishing	71	5.6	
Small business	37	2.9	
Education of the household head (N=1263)			
No schooling	634	50.2	

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Primary school	305	24.1	
Secondary or University	324	25.7	
Children (N=1263)			
Age (months)			
6-8	242	19.2	
9-11	225	17.8	
12-23	796	63.0	
Sex			
Male	645	51.1	
Female	618	48.9	
Mothers			
Age (years) (N=1263)	-		28.3±6.6
Ethnicity (N=1194)			
Adja	45	3.8	
Fon	26	2.2	
Mina	44	3.7	
Kotafon	84	6.7	
Sahouè	967	81.0	
Others	28	2.3	
Education (N=1263)			
No schooling	842	66.7	
Primary school	248	19.6	
Secondary school/University	173	13.7	
Main income sources of mothers (N=1263)			
Salary	18	1.4	
Plant production	398	31.5	
Breeding	233	18.4	
Collectors/Hunting/Fishing	04	0.3	
Small business	551	43.6	

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Table 2: Type of food and level of consumption by children aged 6-23 months (n=1183)

Food groups	Percentages of children who consumed the food group	Local agrobiodiversity foods	Domestication	Percentages of children who consumed food	Consumed portion per child over 24h (g) (Mean ±SD)
Cereals	91.3	Maize	Cultivated	91.2	75.1±99.4
Roots and tubers	25.7	Cassava	Cultivated	23.7	24.9±24.1
		Potato	Cultivated	2.0	51.2±63.9
		Plantain banana	Cultivated	1.4	70.2±57.7
		Yam	Cultivated	0.3	57.5±40.7
Pulses and Nuts	59.8	Palm nut	Cultivated	56.5	30.8±39.6
		Cowpea (seed)	Cultivated	21.6	46.0±44.8
		Peanut	Cultivated	0.9	14.5±7.9
		Coconut	Cultivated	0.1	88.0±0.0
Meats	0.7	Chicken	Domesticated	0.3	22.9±12.5
		Rabbit	Wild	0.1	20.3±0.0
		Sheep	Domesticated	0.1	23.0±0.0
		Pork	Domesticated	0.1	33.3±0.0
		Antelope	Wild	0.1	76.0±0.0
Fish and seafoods	19.4	Tilapia (fish)	Semi-domesticated	16.5	4.7±9.0
		Shrimp	Wild	7.5	0.2±1.0
		Black silurus	Wild	0.7	12±13.7
		Houeti (sahouè)(fish)	Wild	0.2	8.4±4.0
		White silurus	Semi-domesticated	0.1	22.6±0
Leafy vegetables	42.8	Corchorus olitorius L.	Semi-cultivated	24.5	13.2±15.1
		African eggplant	Cultivated	8.8	17.4±16.2
		Ceylon spinach	Wild	6.6	16.5±29.3
		Vernon	Cultivated	3.3	6.6±9.8
		Moringa	Semi-cultivated	1.0	14.9±16.8
		Cowpea	Cultivated	0.8	20.6±18.4
		Cassava	Cultivated	0.5	31.0±22.4
		Amaranth	Cultivated	0.3	19.7±3.5
		Fluted squash	Cultivated	0.3	26.2±29.5
		Dandelion	Semi-cultivated	0.3	19.0±25.2

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		Water spinach	Wild	0.1	43.5±0
		Basil to thymol	Semi-cultivated	0.1	42.9±0
		Wrinkled seed cleome	Semi-cultivated	0.1	4.8±0
		Savannah plums	Wild	0.1	5.3±0
Fruits	5.1	Orange	Cultivated	3.4	57.8±54.3
		Desert banana	Cultivated	1.5	90.8±65.7
		Lemon	Cultivated	0.5	9.3±9.5
		Papaya	Cultivated	0.4	33.7±19.0
		Pineapple	Cultivated	0.1	120.7±0
		Mango	Cultivated	0.1	26.9±0
		Baobab	Wild	0.1	7.1±0
Other vegetables	73.5	Chili pepper	Cultivated	77.7	2.2±2.9
		Tomato (fruit)	Cultivated	38	9.8±9.9
		Okra	Cultivated	13.5	17.1±17.2
		Mushroom	Wild	0.1	5.0±0
Eggs	1.8	Egg	Domesticated	2.0	30.6±22.9
Other foods	0.3	Sugar cane	Cultivated	0.8	123.7±193.4
		Honey/bee	Wild	0.2	10.2±10.1
		Lemongrass	Cultivated	0.2	2.3±1.6

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Table 3: GLM based on gamma distribution with logarithm link adjusted for Vitamin A, Calcium, Iron and Zinc intakes

Vitamin A_RAE (mcg) intake from complementary foods	$\chi^2_{(df=1171)} = 825.40$; P> 0.999 ; $R^2 = 56.22\%$			
Term	**Coefficient**	**Pvalue**	**95% CI**	
(Intercept)	1.4640	0.002	0.5456	2.3824
Wild foods consumption_Yes	0.9652	**0.000**	0.6750	1.2554
Wild foods consumption_No (Reference)				
Agro-ecological zone 6 _ *Houéyogbé*	-0.5851	**0.000**	-0.8066	-0.3636
Agro-ecological zone 8 _ *Bopa* (Reference)				
Age of children	0.1516	**0.000**	0.1045	0.1987
Sex of children_Female	0.0165	0.659	-0.0567	0.0896
Sex of children_Male (Reference)				
Child Breastfed_Yes	1.0820	**0.013**	0.2311	1.9329
Child Breastfed_No (Reference)				
Energy intake	0.0084	**0.000**	0.0075	0.0092
Wild foods consumption _ Yes * Agro-ecological zone 6 _*Houéyogbé*	-0.4999	**0.000**	-0.7622	-0.2376
Wild foods consumption _Yes * Energy intake	-0.0014	**0.001**	-0.0022	-0.0006
Agro-ecological zone 6_ *Houéyogbé*. * Age of children	0.0400	**0.000**	0.0255	0.0545
Age of children * Child Breastfed_ Yes	-0.0521	**0.015**	-0.0940	-0.0102
Age of children * Energy intake	-0.0003	**0.000**	-0.0004	-0.0003

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Calcium (mg) intake from complementary foods	$\chi^2_{(df = 1174)} = 279.77$; P> 0.999; $R^2 = 72.74\%$			
Term	**Coefficient**	**Pvalue**	**95% CI**	
(Intercept)	1.4390	**0.000**	1.2663	1.6117
Wild foods consumption _ Yes	0.4897	**0.000**	0.2770	0.7024
Wild foods consumption_No (Reference)				
Agro-ecological zone 6 _ *Houéyogbé*	-0.0167	0.562	-0.0731	0.0398
Agro-ecological zone 8 _ *Bopa* (Reference)				
Age of children	0.0899	**0.000**	0.0801	0.0997
Sex of children_Female	-0.0146	0.592	-0.0682	0.0389
Sex of children_Male (Reference)				
Child Breastfed_Yes	-0.0844	0.133	-0.1947	0.0259
Child Breastfed_No (Reference)				
Energy intake	0.0077	**0.000**	0.0071	0.0083
Wild foods consumption _ Yes * Agro-ecological zone 6 _ *Houéyogbé*	-0.2477	**0.012**	-0.4399	-0.0555
Wild foods consumption _ Yes * Energy intake	-0.0007	**0.017**	-0.0013	-0.0001
Age of children * Energy intake	-0.0003	**0.000**	-0.0003	-0.0002
Iron (mg) intake from complementary foods	$\chi^2_{(df = 1171)} = 83.52$; P > 0.999; $R^2 = 86.50\%$			
Term	**Coefficient**	**Pvalue**	**95% CI**	
(Intercept)	-1.2180	**0.000**	-1.5843	-0.8517
Wild foods consumption _ Yes	0.0372	0.132	-0.0112	0.0856

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Wild foods consumption_No (Reference)				
Agro-ecological zone 6 _ *Houéyogbé*	0.0848	**0.046**	0.0015	0.1682
Agro-ecological zone 8 _ *Bopa* (Reference)				
Age of children	0.0949	**0.000**	0.0770	0.1127
Sex of children_Female	-0.0139	0.323	-0.0415	0.0137
Sex of children_Male (Reference)				
Child Breastfed_ Yes	0.3069	0.073	-0.0286	0.6424
Child Breastfed_No (Reference)				
Energy intake	0.0058	**0.000**	0.0053	0.0063
Agro-ecological zone 6 _ *Houéyogbé*.* Age of children	-0.0088	**0.010**	-0.0155	-0.0021
Agro-ecological zone 6 _ *Houéyogbé*.* Energy intake	0.0003	**0.000**	0.0002	0.0005
Age of children * Child Breastfed_ Yes	-0.0347	**0.000**	-0.0505	-0.0188
Age of children* Energy intake	-0.0002	**0.000**	-0.0002	-0.0002
Child Breastfed_ Yes * Energy intake	0.0008	**0.000**	0.0005	0.0010
Zinc (mg) intake from complementary foods	$\chi^2_{(df = 1170)} = 88.73$; $P > 0.999$; $R^2 = 84.82\%$			
Term	**Coefficient**	**Pvalue**	**95% CI**	
(Intercept)	-1.9320	**0.000**	-2.3189	-1.5451
Wild foods consumption _ Yes	-0.0457	0.259	-0.1251	0.0336
Wild foods consumption_No (Reference)				
Agro-ecological zone 6 _ *Houéyogbé*	0.0926	**0.040**	0.0044	0.1809

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Agro-ecological zone 8 _ *Bopa* (Reference)				
Age of children	0.0895	**0.000**	0.0707	0.1084
Sex of children_Female	-0.0145	0.330	-0.0436	0.0147
Sex of children_Male (Reference)				
Child Breastfed_ Yes	0.2028	0.262	-0.1515	0.5571
Child Breastfed_No (Reference)				
Energy intake	0.0051	**0.000**	0.0046	0.0057
Wild foods consumption _ Yes * Agro-ecological zone 6 _ *Houéyogbé*	0.1201	**0.023**	0.0164	0.2238
Agro-ecological zone 6 _ *Houéyogbé* * Age of children	-0.0087	**0.015**	-0.0158	-0.0017
Agro-ecological zone 6 _ *Houéyogbé*.* Energy intake	0.0003	**0.002**	0.0001	0.0005
Age of children * Child Breastfed_ Yes	-0.0356	**0.000**	-0.0524	-0.0188
Age of children * Energy intake	-0.0002	**0.000**	-0.0002	-0.0002
Child Breastfed_ Yes * Energy intake	0.0010	**0.000**	0.0007	0.0013

χ^2 = statistic of the Chi-2 fit test (residual deviation of the adjusted model); df = number of residual degrees of freedom; R^2 = pseudo-determination coefficient of Nagelkerke [42]; the coefficients express relative variations in the response

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