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CONTRIBUTION TO THE INVENTORY AND CHEMICAL CHARACTERIZATION OF SOME TRADITIONAL DISHES OF THE PEOPLE COMING FROM THE CENTER-WEST OF CÔTE D'IVOIRE: CASE OF BETES DIETS IN DALOA

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ABSTRACT

This study deals about aimed inventairy of traditional foods consumed by Bete's peopple of Daloa (Western center of Côte d'Ivoire). Theses dishes are prepared from exclusively by végétales plantes. Foods venacular names and they laefy vegetables component were carrng after nutritional survey. Nutritive value were determined by standard AOAC methods. The contents in moisture, proteins, lipids, fibres and carbihydrates are determined. The results obtained are expressed in g/100 g fw for moisture and in g/100 g dw for proteins, lipids, fibres and carbihydrate. The moisture content ranged from 57,96 (*Lèlè messi*) to 80,07 (*Kpessi*); proteins, from 6,01 (*Djadre seka*) to 32,91 (*Sohoun seka*); lipids, from 4,72 (*Gôko seka*) to 64,63 (*Toko soukouè*); fibres, from 2,80 (*Gboplè*) to 38,80 (*Siohohi lokosoukouè*); carbohydrates, from 4,79 (*Yôyô*) to 73,40 (*Kpessi*).

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INTRODUCTION

Every human being has the right to adequate food. The progressive realization of this right everywhere in the world is inseparable from the existence of functional and sustainable food systems. In addition, it must ensure the food and nutrition security of all, in sufficient quality and quantity, and culturally acceptable (HLPE, 2017). However, malnutrition in all its forms (undernutrition, micronutrient deficiencies, overweight and obesity) still exists today and constitutes a major obstacle to sustainable development. At present, some 0.8 billion people still suffer from hunger, more than 2 billion have essential vitamin or mineral deficiencies, and some 1.9 billion adults are affected by overweight or high blood pressure. obesity. Hunger has declined in recent decades, but it should not be forgotten that overweight and obesity are growing rapidly worldwide, including in low- and middle-income countries (FAO / IFAD / UNICEF / WFP / WHO, 2017). However, even in high-income countries, there are areas that can be described as "deserts" or "quagmires" from the point of

view of food availability. (Walker et al., 2010, Rose et al., 2010). Malnutrition, in any form, is a result of poor diets, lack of knowledge and resources, and adverse environments, all of which have underlying causes (FAO, 2013). The consequences of malnutrition on human health, as well as its economic, social and environmental consequences, are exorbitant. The economic costs of malnutrition are high and the burdens they generate are transmitted from one generation to the next, because a mother who is not properly nourished is more likely to give birth to children, who in turn will be malnourished, even into adulthood (WHO, 2010). If current trends continue, the costs of collective mismanagement of global natural resources and food systems observed today will increase (IFPRI, 2016). The availability of food does not in itself guarantee satisfactory food security and nutrition at the community or household level (Duran et al., 2015, Feng et al., 2010, Holsten, 2009, Glanz et al., 2005). It is imperative to turn to an innovative, collective and integrated approach to natural resource management. Among the Betes peoples, no such study has yet been conducted and this is what justifies the choice of the present study carried out in the region of Daloa,

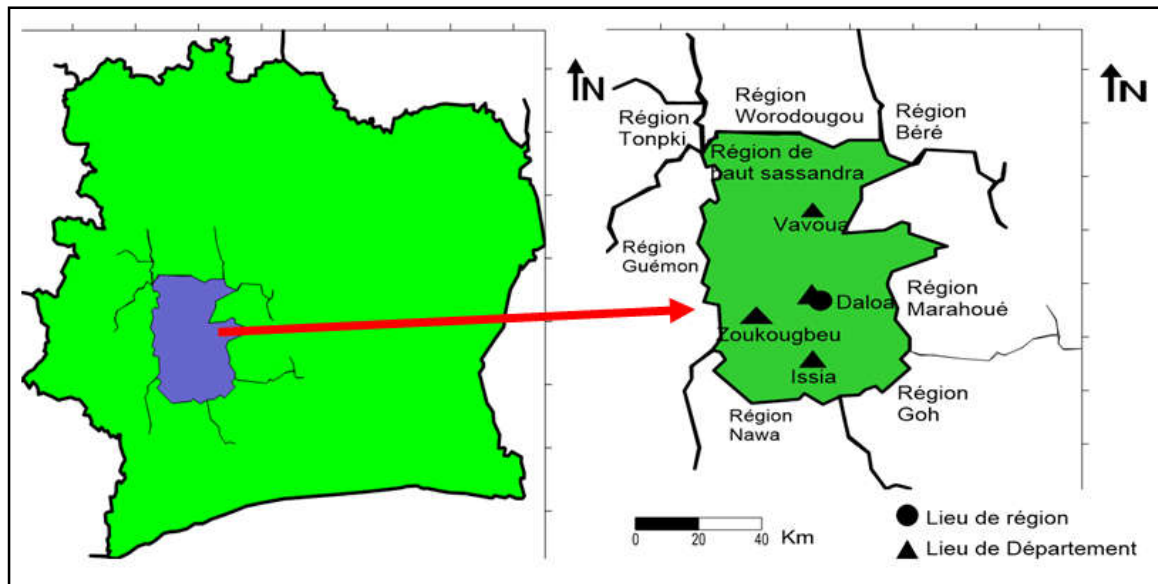


Figure 1. Location of Daloa

chief town of the Haut Sassandra region. This work aims to identify the traditional diets of this people in central-western Côte d'Ivoire and to evaluate the nutritional potential and a food alternative in order to face the many health challenges of our contemporaries.

MATERIALS AND METHODS

Study area: The city of Daloa is located in the center-west of Côte d'Ivoire in the region of Upper Sassandra. It is bathed on its western flank by the upper course of the Sassandra River from which it derives its name (the upper Sassandra) which covers an area of 15205 km² with a population estimated at 1 534 100 inhabitants (INS, 2014).

The region of Upper Sassandra is limited as follows:

- In the North, the region of Worodougou (Seguela) and Bere (Mankono);
- To the East, the region of Marahoué (Bouafle);
- In the South, the regions of Gôh (Gagnoa) and Nawa (Soubre);
- In the West, the regions of Tonkpi (Man) and Guémon (Duekoue).

The city of Daloa is the chief town of Upper Sassandra region. It is located 383 km from the city of Abidjan and 141 km from Yamoussoukro. With an area of 530.5 hectares or 5,305 km². The Department of Daloa occupies 28% of the surface of the Upper Sassandra region. It is made up of six sub-prefectures (Daloa, Bédiala, Gadouan, Gboguhé, Gonate and Zaïbo).

The Department of Daloa is limited:

- in the North by the departments of Vavoua;
- in the South by the department of Issia;
- in the West by the department of Zoukougbeu.

To the East by the city of Gonate

Biological materials: Traditional diets of the Betes people, are made from cultivated or spontaneous food plants.

Study method

Nutritional survey: Before the actual food surveys, surveys were carried out in the department for village selection. Four villages were chosen according to their geographical position relative to the city of Daloa, they are TCHEBLEGUHE (in the South), ZOKOGUHE (in the North), DIGBAPIA (in the West) and ZEPREGUHE (in the East). These villages were selected in relation to their proximity to other towns in the Haut-Sassandra region. The survey was based on an interview of twelve (12) women per village randomly selected, ie 48 women in total. We submitted a questionnaire index to the respondents. These questionnaires should allow us to know what are the traditional diets consumed by the Betes people of the Daloa region. What are the major ingredients in the making of these dishes, their availability in their environment? It was also necessary to know if these plans were still regularly made. Where possible, photographs were made for a better identification of the ingredients used in the making of these traditional dishes.

Chemical analysis

Chemical analysis of dishes: the moisture content was determined by drying the fresh dish in an oven at 105°C until constant weight, ash by incineration in a muffle furnace at 505°C for 48h, proteins by nitrogen determination using the kjeldahl method and conversion of nitrogen to proteins by the 6,25, total lipids by extraction in a Soxhlet apparatus for 6h using petroleum ether as solvent fibers by successive digestion of the defatted sample with 0,26N, sulfuric acid and 0,23N potassium hydroxyde solution and carbohydrates by difference method (AOAC, 1998).

Statistical analysis: All analyses were performed in triplicate. The results are presented in the form, mean±standart deviation. Statistical version 10.1 at a threshold of $p < 0,05$. The analysis of variance (ANOVA) was used to detect difference in values (means).

RESULTS

Table 1. Traditional dishes eaten by Bétés peoples of Daloa

Vernacular names	Characteristics	Main ingredients	Scientific names of main ingredients	Form s of consumption
<i>Siokohi lokosoukouè</i>	kaklou sauce (Siako)/crushed banana	Dry fish+ seeds powder of <i>Irvingia g.</i> +dry black mushrooms handful +palm mushrooms handful+ shrimp powder+peppers powder+ripe plantain+salt	<i>Irvingia gabonensis ; Psathyrella atroumbonata ; Volvariella volvacea ; Musa sapientum</i>	2 Pieces
<i>Houhou messi</i>	grilled banane with peppers	Plantains +peppers powder +seeds of <i>Ricinodendron h.</i>	<i>Musa sapientum ; Capsicum frutescens ;</i>	1 Piece
<i>Lolalalé-soukouè</i>	sioko sauce with leaves vegetable	seeds powder of <i>Irvingia g. (kaklou)</i> + black mushrooms +palm mushrooms +leafy of <i>Myrianthus arboreus</i> (vegetable)+young leafy of <i>Colocasia e. (Gbessi)</i> + fresh peppers+salt	<i>Irvingia gabonensis ; Psathyrella atroumbonata ; Volvariella volvacea ; Myrianthus arboreus ; Colocasia esculenta ; Capsicum frutescens</i>	2 Pieces
<i>Zohoun seka-tikliti</i>	Palm seed sauce with leaves of <i>tikliti</i>	Beef legs+snails+dry fish+ leafy of <i>Myrianthus arboreus</i> (vegetable)+ seeds of palm oil+fresh peppers+salt	<i>Myrianthus arboreus ; Elaeis guineensis ; Capsicum frutescens</i>	2 Pieces
<i>Djibiyèpo</i>	Baked rice sprinkled with a mixture of pepper, <i>akpi</i> and fish	Local rice+Crumble dry fish+ seeds of dry peppers+seeds of <i>Ricinodendron h.</i>	<i>Oriza sativa; Capsicum frutescens ; Ricinodendron heudelotii</i>	1 Piece
<i>Gbloloyibehou</i>	black mushrooms sauce	Dry fish+dry black mushrooms +dry palm mushrooms +powder of peppers+salt	<i>Psathyrella atroumbonata ; Volvariella volvacea ; Capsicum frutescens</i>	1 Piece
<i>Gbitèseka</i>	<i>Beilschmeedia mannii</i> sauce like Betes	Dry fish (capitaine)+Black mushrooms +palm mushrooms+ powder of peppers +seeds of <i>Beilschmeedia m. (Siako or Kplé ; bouket)</i> +salt	<i>Psathyrella atroumbonata ; Volvariella volvacea ; Capsicum frutescens ; Irvingia gabonensis ou Beilschmeedia mannii</i>	2 Pieces
<i>Kpessi</i>	Plantain stew	Plantains+dry fish +palm oil+salt	<i>Musa sapientum ; Elaeis guineensis</i>	1 Piece
<i>Toko soukouè</i>	Palm seeds sauce , <i>taro</i> pounded	Dry fish (Silure)+dry meat (beef) + seeds of palm oil+pounded of <i>Colocasia e.</i> +salt	<i>Elaeis guineensis ; Colocasia esculenta</i>	2 Pieces
<i>Gblobblo seka</i>	Vegetables sauce: <i>gombos, taro</i> and <i>tikliti</i>	Crumble fish+ leafy of <i>Abelmoschus e.</i> +leafy of <i>Colocasia e.</i> + leafy of <i>Solanum a. (tikliti)</i> + fermented fish (<i>Adjévan</i>)+african black mushrooms + hill mushrooms + fresh okra+eggplant	<i>Abelmoschus esculentus ; Colocasia esculenta ; Psathyrella atroumbonata ; Solanum aethiopicum</i>	2 Pieces
<i>Zohoun seka</i>	Fatty rice (Bete)	Dry fish (Machoirons)+seeds of palm oil+rice+salt	<i>Elaeis guineensis ; Oriza sativa</i>	1 Piece
<i>Yôyô</i>	Pounded plantains (Bete)	Plantains+ seeds of palm oil +eggplant+seeds of <i>Ricinodendron h.</i> +dry peppers +salt	<i>Musa sapientum ; Elaeis guineensis ; Solanum aethiopicum ; Ricinodendron heudelotii ; Capsicum frutescens</i>	1 Piece
<i>Lobiè</i>	Palm seeds sauce / fatty banana	Dry meat of beef +seeds of palm oil+fresh peppers +plantains +salt	<i>Elaeis guineensis ; Capsicum frutescens ; Musa sapientum</i>	1 Piece
<i>Djladrè seka</i>	Palm heart (vegetables) palm seeds sauce	Seeds of palm oil+ palm heart (vegetable)+fresh peppers + local rice+ leafy of <i>Thaumatococcus d.</i> + salt	<i>Elaeis guineensis ; Capsicum frutescens ; Oriza sativa ; Thaumatococcus danielli</i>	2 Pieces
<i>Gôkô seka</i>	Palm seeds sauce /leaves pellets of black morelles	Snails+seeds of palm oil+ black leafy of <i>Solanum n. (Goko)</i> +fresh peppers	<i>Elaeis guineensis ; Solanum nigrum ; Myrianthus arboreus</i>	1 Piece
<i>Seka minmin</i>	Stuffed rice residues	Rice+leafy of <i>Thaumatococcus d.</i>	<i>Oriza sativa ; Thaumatococcus danielli</i>	1 Piece
<i>Yibègnouwlolo</i>	Clear sauce	fish+eggplants +fresh okra+ tomato+powder peppers+ fermented fish (<i>adjuevan</i>)+peppers+salt	<i>Solanum aethiopicum ; Abelmoschus esculentus ; Solanum lycopersicum ; Capsicum frutescens</i>	2 Pieces
<i>Gboplè</i>	<i>taro</i> Stew	<i>Colocasia e.</i> +snails+seeds of palm+salt	<i>Colocasia esculenta ; Elaeis guineensis</i>	1 Piece
<i>Lèlè messi</i>	Red beans cooked with chilli and red oil	Red bean+ palm oil+ seeds of <i>Ricinodendron h.</i> + powder peppers +green plantains + salt	<i>Phaseolus vulgaris; Ricinodendron heudelotii ; Capsicum frutescens ; Musa sapientum</i>	1 Piece

Table 2. Nutritive value of dishes consumed by Bete's people coming from Daloa

Food	Water content (g/100g fresh weight)	Protein	Lipids (g/100g fresh weight)	Crude fibre	carbohydrate
<i>Siokohi lokosoukouè</i>	78.01±4.12	12.75±1.22	16.50±1.22	38.80±1.52	24.11±9.21
<i>Houhou messi</i>	78.82±0.38	16.86±2.10	7.01±0.89	12.92±4.54	47.32±7.12
<i>Lolalalè-soukouè</i>	74.09±2.41	7.82±0.16	10.64±0.93	15.05±3.49	61.42±4.94
<i>Zohoun seka-tikliti</i>	83.02±2.44	11.34±0.71	28.97±3.23	9.79±1.75	42.18±1.08
<i>Djibiyibèpo</i>	77.75±1.33	10.23±1.38	17.52±0.08	14.97±1.90	51.67±0.74
<i>Gbloloyibehou</i>	75.25±0.47	11.20±0.03	16.86±1.36	14.68±1.77	52.78±3.01
<i>Gbitèseka</i>	79.93±0.29	13.10±1.15	16.33±4.82	14.93±1.19	47.43±5.95
<i>Kpessi</i>	80.07±1.16	9.27±1.35	16.48±4.20	9.05±0.57	73.40±2.56
<i>Toko soukouè</i>	76.51±0.57	10.22±0.24	64.63±0.05	15.97±0.94	47.52±1.78
<i>Gblobblo seka</i>	59.32±0.36	13.01±0.11	21.84±0.32	7.83±1.10	53.53±0.36
<i>Zohoun seka</i>	74.46±0.37	32.91±3.09	31.78±4.81	7.13±0.48	18.87±0.21
<i>Yôyô</i>	82.54±2.57	24.70±0.07	47.74±0.97	15.11±1.20	4.79±1.50
<i>Lobiè</i>	79.93±0.29	11.09±0.14	16.46±0.36	5.70±0.60	61.52±1.65
<i>Djladrè seka</i>	86.70±0.83	6.01±0.16	63.25±6.36	6.36±1.18	16.78±0.56
<i>Gôkô seka</i>	70.13±4.30	7.74±0.46	4.72±0.50	15.97±0.75	58.12±0.43
<i>Seka mimmin</i>	59.28±2.59	13.10±1.15	16.33±4.52	14.93±1.19	47.43±5.95
<i>Yibègnouwololo</i>	62.87±2.1	12.52±1.16	17.27±3.83	4.96±0.36	62.10±2.91
<i>Gboplè</i>	68.32±0.62	8.49±1.15	22.51±0.44	2.80±0.41	62.52±2.96
<i>Lèlè messi</i>	57.96±0.86	17.85±3.39	24.40±0.64	3.18±0.39	50.86±2.96

There is a significant difference between the nutriment in the dishes

DISCUSSION

Fruits or seeds and leaves dominate among the organs sold as the main ingredients of the diets in the markets. These results corroborate those of (Betti and Mebere, 2011, Hamawa, 2013) and the Douala markets (Priso et al., 2011, Dibong et al., 2011). Similar results were also obtained in the Democratic Republic of Congo, particularly in the Kinshasa (Mutambwe and Shango, 2010) and Kisangani markets (Temote et al., 2012). The importance of the fruits or seeds is due to their high nutritional value and the dietary practices of these people in west-central Côte d'Ivoire (Betti et al., 2016). Condiments and plant products are the most widely used types of uses in the Daloa markets. These results corroborate those of Betti and Mebere (2011) in the Far North of Cameroon. Species such as *Beilschmeedia manni*, *Irvingia gabonensis*, *Ricinodendron heudelotii*, *Elaeis guineensis* etc. when sold in the market, are most often as condiments in dried form, fresh, in the form of dough (Betti et al., 2016). The use of leaves and fruits in food has been widely reported in Cameroon, particularly in the Far North region (Betti and Mebere, 2011). Thus, food plants are reduced to powder or paste for use in cooking (Apema et al., 2010). Vegetables, like other forms of consumption of food plants, play an important role in the well-being of rural communities in developing countries (Asfaw and Tadesse, 2011). Green leafy vegetables are an essential component of human nutrition in Africa in general, and particularly in West Africa in food confectionery in general (Kubmarawa et al., 2009).

Indeed, leafy vegetable dishes are often prepared with a single plant species or a combination of different species in order to add flavor, taste, color and aesthetic appeal to the diet (Marchall, 2001, Fasuy, 2006). These leafy vegetables are important protective foods and are extremely beneficial for maintaining health and preventing disease as they contain valuable food ingredients that can be used to strengthen and repair the body (Falade et al., 2003). In addition, these plants are valuable sources of nutrients, especially in rural areas, where they contribute substantially to proteins, fats, minerals, vitamins, fibres and other nutrients inputs. , which are generally rare in the daily diet (Mohammed and Sharif, 2011).

They are also a good source of antioxidants (Gupta and Prakash 2011, Sikora and Bodziarczyk 2012). These species also contain some antinutritional factors such as oxalates and phytates, which must be removed during cooking to improve their nutritional qualities (Acho et al., 2014). In fact, leafy vegetables are a good source of fiber (Soro et al., 2012), they are harvested and transported to different markets in Daloa. Treatments applied to leafy vegetables during storage or storage prior to market sale have little impact on soluble fiber levels related to pectin sensitivity (Sun et al., 2000). Fibers are also important for the body because they intervene in the digestive tract and prevent the absorption of excess cholesterol (Mensah et al., 2008). The diverse nutritive and health functions of plants in traditional culture, and the indigenous knowledge of plant diversity, offer potentially valuable solutions that enable biodiversity to cope with the problems confronting contemporary society (Timothy John, 2003). Moisture content ranged from 59.32g/100g fw (*Gblobblo seka*) to 86.70g/100g fw (*Djladrè seka*) with significant differences between all dishes ($p < 0.05$). High water content of these dishes is due to a variable intake of water during the preparation of these dishes. Water content of *Gboplè* (68.32g/100g fw) is not statistically different compared to the value obtained by Fokou et al (2009) 65g/100g fw on certain dishes consumed in western Cameroon.

Protein value ranged from 6.01g/100g dw (*Djladrè seka*) to 32.91g/100g dw (*Zohoun seka*) with a significant difference between all prepared dishes ($p < 0.05$). *Djladrè seka* (32.91g/100g dw) at the highest protein value. Higher consumption of this dish should be encouraged, especially for children and pregnant women, to combat malnutrition. This protein value obtained with *Djladrè seka* is similar to that obtained by Ponka et al. 2005 (32.2g/100g dw) in dishes prepared from peanut seeds and Egusi consumed at Ngali II (Cameroon). These prepared meals are composed of several ingredients (vegetables and animals) that could be used to improve protein intake in young children at high risk of energy and energy malnutrition during the complementary feeding period (Sop et al., 2008). Lipid content ranged from 4.72g/100g dw (*Gôkô seka*) to 64.63g/100g dw (*Toko soukouè*) with a significant difference between all dishes ($p < 0.05$).

Lipid levels are higher than those reported by Ponka et al., 2005 (7.79 to 17.6g/100g dw). The main source of fat in the dishes analyzed is palm oil, which increases the lipid levels of the dishes as opposed to the other ingredients used in the preparation. Therefore, red palm oil used in the preparation of dishes provides beta-carotene, a precursor of vitamin A (Booth et al., 1992). This vitamin between several roles promotes growth, protects the body against cancer, contributes to the fight against infections and plays an important role in the vision (Semba and Bloem, 2001). These high levels of lipids are due to poor knowledge of the recommendations for good nutrition. They contribute to increasing the prevalence of overfeeding that has caused many chronic diseases in developing and developed countries (FAO, 2005). Crude fibers ranged from 2.80g/100g dw (*Gboplè*) to 38.80g/100g dw (*Siokohi lokosoukouè*) with a significant difference between all dishes ($p < 0.05$). Fiber is important because it protects the body against bowel cancer, diabetes and cardiovascular disease. They also facilitate cellular hydration (Afass, 2002). Carbohydrate contents are between 4.79g/100g dw (*Yôyô*) and 73.40g/100g dw (*Kpessi*) with a significant difference between the dishes ($p < 0.05$). The carbohydrate contents are between 4.79g/100g dw (*Yoyo*) and 73.40g/100g dw (*Kpessi*) with a significant difference between the dishes ($p < 0.05$). These high levels of carbohydrate are justified by the presence in the diet of energy foods such as taro (*Colocasia esculenta*), rice (*Oriza sativa*), plantain (*Musa sapientum*) etc.

Conclusion

The diets of the Bétés peoples of Daloa consist of two pieces of food. This diet consists of a main carbohydrate diet (taro (*Colocasia esculenta*), rice (*Oriza sativa*), plantain (*Musa sapientum*)) and a side dish (sauce). All these dishes come from plant and animal products found either on the markets or in the forests (spontaneous food plants). In addition, these diets are proving to be a good provider of essential nutrients especially since the levels obtained from them are largely high for many of them compared to the recommendations of the FAO. These traditional dishes would benefit from being popularized in a specific way in the fight against malnutrition and also in strengthening the nutritional status of individuals confronted with these many noncommunicable nutritional diseases.

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