Research article

Fruits seasonality in selected markets at Mont-Ngafula district in Democratic Republic of the Congo: Biodiversity and food values

Mike Mukendi Tshibangu, Gédéon Bongo Ngiala, Anthony Kikufi Batoba, Eric Bukaka Wakini Yeto, Koto-te-Nyiwa Ngbolua, Henry Mbale Kunzi and Félicien Lukoki Luyeye*

Department of Biology, Faculty of Science, University of Kinshasa, B.P. 190, Kinshasa XI, Kinshasa, Democratic Republic of the Congo

*Corresponding Author: gedeon.bongo@unikin.ac.cd

[Accepted: 15 October 2018]

Abstract: Fruit seasonality remains so far one of the priorities of agricultural research and development in the Democratic Republic of the Congo. However, due to the lack of reliable statistics and a schedule, it seems unappreciated and underestimated. This situation limits the prospect of fruit resource promotion and justifies the initiation of the current study of which the objective was to assess the biodiversity and fruit food value available according to the season in Kinshasa. The survey was carried out between January and June 2016 in the Lukunga district, particularly in Mont-Ngafula township where 100 vendors of fruits in selected markets of this township were interviewed. In the current survey, about twenty fruits sold on these markets were recorded and these fruits belong to 22 families dominated by *Anacardiaceae* and *Rutaceae* families. It was observed that the greater varieties of fruits were available in February than in June. It was noted that papaya, banana, coconut and apples were present from January to June while mangosteens, fewer passion fruits, rambutan and pink apples were only present in January and February. These findings showed that the sale of fruit is a very profitable activity. All these elements are important for they serve as the basis for the development of a research strategy for the promotion of fruit resources in DRC.

Keywords: Biodiversity - Fruits - Seasonality - Socio economic - DRC.

[Cite as: Tshibangu MM, Ngiala GB, Batoba AK, Yeto EBW, Ngbolua K-te-N, Kunzi HM & Luyeye FL (2018) Fruits seasonality in selected markets at Mont-Ngafula district in Democratic Republic of the Congo: Biodiversity and food values. *Tropical Plant Research* 5(3): 275–285]

INTRODUCTION

Given the socio-economic realities of various developing countries (insufficient or non-existent income, scarcity of employment, chronic food insecurity, etc.) among which is included the Democratic Republic of the Congo (DRC), the population in order to maintain its survival has developed diverse lucrative activities among which the exploitation of non-timber forest products (NWFPs) (Ndjebet 1997, Sene 2001, Biloso 2006). According to Tollens (2003), the economic growth for the poor appears as a prescriptive side of neoliberal epistemology for the improvement of the well-being of populations, accompanied by a reduction of poverty. In this perspective, the promotion of economic sectors in which the poor are active has become a miracle recipe for poverty reduction. In Sub-Saharan Africa, a significant proportion of poor lives on the exploitation of natural resources. Besides lumber, energy wood, forest, grassland and aquatic ecosystems deliver products that are commonly needed and sold in most major consumption centers. These products are resources of various and indispensable utilities (Tchatat *et al.* 1999).

The current food crisis and the continuing deterioration of the health status of the Congolese population in general and of Kinshasa city, in particular, are among the causes of strong pressure on natural environments including forests. In the long run, these may create scarcity or disappearance of certain resources and cause drought, erosion and desertification. On the other hand, according to FAO, the uncontrolled exploitation of natural resources could severely limit future prospects for the economic growth for the poor and development (FAO 2001). This suggests that the sustainable and rational exploitation of natural resources could contribute,

not only to the preservation of a significant part of the biodiversity of ecosystems in peri-urban and rural areas of Kinshasa city but also to the improvement of the fate of many local communities. Through the income generation and the equitable distribution of richness from the exploitation of natural resources. The country is going through a crisis that has reached a critical nutritional threshold today. The Congolese population is malnourished and, lacking enough food in quantity and quality, draws what they need from their natural environment: these are the products of the biodiversity provided by wild flora and fauna as well as agricultural commodities. This production has been tested for more than 20 years by the climatic changes that the country undergoes, without forgetting the agricultural production threatened in the same way with consequently the fall in yield resulting from the disturbance of the agricultural calendar. Fruits are essential to the body and contribute to its development with its vitamin intake including vitamin C which is in large quantities, minerals precisely electrolytes, dietary fibers and antioxidants (phytochemicals) which prevent against cancer and ageing (Muraki *et al.* 2013, Dhandevi & Jeewon 2015). The only problem with fruits is that most people do not know how to consume them in order to effectively assimilate nutrients (Combe 1982). Several studies reported that there is an association between low intake of fruits with chronic diseases like cardiovascular diseases, blood pressure, hypercholesterolemia, osteoporosis, many cancers, chronic obstructive pulmonary diseases, respiratory problems as well as mental health (Adebawo *et al.* 2006, Park *et al.* 2011, Payne *et al.* 2012, Dhandevi & Jeewon 2015).

Fruits are the best foods that are consumed in order to protect the body against heart disease for instance and many others diseases; they contain bioflavonoids that can prevent the thickening of blood as well as the obstruction of arteries. In addition, they strengthen capillaries and fragile capillaries are almost the cause of internal bleeding and heart attacks (Merlin 2012). Fruits are mainly composed of fructose as the main sugar (which can be easily converted into glucose), the rest is mainly water (90 to 95%) (Merlin 2012). Fruits are a group of foods that should not be missed in your diet because of their high fiber, vitamin and mineral contents and are excellent for maintaining regular bowel movements and skin health, hair and all our organs (Merlin 2012). Fruits are consumed by many groups of animals, with many examples of coevolution and most of the terrestrial mammals like fruits, even among which are supposed to be carnivorous. In the great apes, their share in the diet may suggest that which concerned the Australopithecus and the first Homo (Muraki *et al.* 2013). This is why in the present work, it was a question of knowing the seasonality of fruits available and marketed in different markets of Kinshasa, which was oriented in the identification of the fruits on the markets as well as their source of origin. The main objective was to know the seasonality of fruits present in various markets of Kinshasa. The specific objectives were to make an inventory of the fruits sold in four markets of Mont-Ngafula township (Kinshasa city) each month pending 2016, establish the list of the fluctuation of fruits as well as identify their sources of origin. The seasonality of fruits in the markets of Kinshasa is not scientifically determined; this shows the significance of this research. Practically, this study allows to know the correct period (the availability) of having a fruit in the market.

MATERIAL AND METHODS

Study area

The Mont-Ngafula township is located in the southwest of Kinshasa city. It is bounded in the North by Makala, Selembao, Lemba and Kisenso townships; in the South by Kasangulu Territory (Kongo-Central Province); in the East by Ndjili, Kimbanseke and N'sele townships; and in the West by Ngaliema township and the Republic of Congo (Brazzaville). Mont-Ngafula township has an area of 358.90 km² and has a mild tropical warm and humid tropical climate that originates from hill breezes at a certain time of the day, blow from low valleys to peaks in there bringing certain freshness. Two types of soils characterize the aforementioned township, namely the soils of hills and those of valleys. In fact, the hilly soils are covered by the soft, whitish sandstone where there is a predominance of fine ocher-yellow sand while the second seems to be the most fertile and therefore consist of silt. This explains the high concentration of agricultural activities in valleys such as Funa, Lukaya and Lukunga. Mont-Ngafula township has a wooded and grassy savannah and it is a derived savannah of anthropic origin. It has to be noted that Mont-Ngafula township is drained by a multitude of small rivers South-North direction that flow into the Congo River in the west and the N'djili River in the east.

Material

The biological material used for the current survey was samples of food fruits collected in four markets in the western part of Kinshasa city notably UPN, Matadi-Kibala, Cité Pumbu and Masanga-Mbila.

Methodology

For the current study, the direct interview survey and direct observation were used as well as the literature search. After the site exploration, the next step was the interview, using a pre-elaborated questionnaire. The use of more than one market was an appropriate strategy in order to verify the veracity of the information received from various informants. In our surveys, the following information was needed: the fruits found on the market, their use, the techniques for preserving products, the ecological environment in which the products (fruits) were collected, the provenance, and finally any other relevant additional information. The survey was carried out between January and June 2016 in the Lukunga district, particularly in Mont-Ngafula township and 100 vendors of fruits in selected markets were interviewed in total.

Collection and plant identification for herbarium formation

The constitution of a reference herbarium is a necessary basis in any floristic inventory study. We bought leafy plants sold by different informants to construct a herbarium, this allowed us to identify some plants on the field. To ensure the correct determination of these plants, the main floristic works of the neighboring countries and Central Africa namely the Flora of Gabon, the Central African Flora, the Flora of Cameroon and the Flora of the Belgium-Congo was used. The ascertaining of our determinations were compared with specimens kept at the Herbarium, in the Department of Biology, Faculty of Science, University of Kinshasa.

RESULTS

Socio-demographic characteristics of informants

The socio-demographic characteristics of informants considered in the current survey are gender and marital status (Fig. 1). The above figure shows that the majority of vendors are female because they are predominant in selected markets. The percentage of female vendors of the UPN, Matadi Kibala, Cité Pumbu and Masanga-Mbila markets are 100%, 80%, 100% and 75% respectively. This explains that the exploitation and sale of fruits are the responsibility of females than males.

Figure 1. Distribution of vendors according to gender in selected markets.

The figure 2 shows that married people represent the large group of vendors of NWFPs in these markets and their proportion is as follows: UPN market (46.9%), Matadi-Kibala market (40%), Cité Pumbu market (53%) and Masanga-Mbila market (50%).

The other groups namely bachelors and divorced are represented as follows in different markets. According to the markets, the proportion of bachelors ranges between 26.9% and 40.6% while the proportion of divorced ranges between 9.4% and 30%. Unfortunately, during the interview, no widows were recorded. It is obvious that the fruit trade is a function of the marital status of the vendor. Married people have significant social security contributions; henceforth the need to resort to an income-generating activity compared to bachelors and divorced people.

Diversity and nomenclature of fruits

In the current survey, about twenty fruits on sale in different markets were recorded (Table 1; Fig. 3) and these fruits belong to 22 families dominated by *Anacardiaceae* and *Rutaceae* families. The general situation of fruits recorded over six months is presented in tables 1 and 2 below.

Figure 2. Distribution of vendors according to marital status in selected markets.

Table 1. Names of different fruits found in selected markets.

Scientific Name	Vernacular Name	Botanical Family	Frequency of fruits in selected markets
<i>Aframomum albobviolaceum</i> K.Schum.	Ntundulu	Zingiberaceae	++
<i>Ananas comosus</i> (L.) Merrill.	Ananas (F)	Bromeliaceae	+++
<i>Anisophyllea quangensis</i> Engl. ex Henriques	Mbila esobé (L)	Anisophylleaceae	+++
<i>Annona muricata</i> L.	Mbundu ngombe (K)	Annonaceae	++
<i>Averrhoa carambola</i> L.	Carambole (F)	Oxalidaceae	+
<i>Carica papaya</i> L.	Papaye (F)	Caricaceae	+++
<i>Citrullus lanatus</i> (Thunb.) Matsum.& Nakai	Pastèque (F)	Cucurbitaceae	+++
<i>Citrus limon</i> L. Burm. f	Citron (L)	Rutaceae	++
<i>Citrus reticulata</i> Blanco	Mandarine (L)	Rutaceae	++
<i>Citrus sinensis</i> L. Osbeck.	Orange (F)	Rutaceae	++
<i>Cocos nucifera</i> L.	Noix de coco (F)	Arecaceae	+++
<i>Cola acuminata</i> (P.B.) Schott & Endl	Noix de cola (F)	Malvaceae	++
<i>Dacryodes edulis</i> (G.Don) H.J.Lam	Safou (L)	Burseraceae	++
<i>Garcinia mangostana</i> L.	Mangoustan (F)	Clusiaceae	++
<i>Landolphia owariensis</i> P. Beauv.	Litongé (L)	Apocynaceae	++
<i>Malus domestica</i> Borkh.	Pomme(F)	Rosaceae	+
<i>Mangifera indica</i> L.	Mangue (F)	Anacardiaceae	++
<i>Musa</i> sp.	Banane (F)	Musaceae	+++
<i>Musa x paradisiaca</i> L.	Banane plantain (F)	Musaceae	+++
<i>Nephelium lappaceum</i> L.	Poilus (L)	Sapindaceae	+
<i>Passiflora edulis</i> Sims.	Maracuja (L)	Passifloraceae	+
<i>Persea americana</i> Mill.	Avocat (F)	Lauraceae	++
<i>Solanum lycopersicum</i> L.	Tomate (F)	Solanaceae	++
<i>Solanum melongena</i> L.	Aubergine (F)	Solanaceae	+
<i>Spondias cytherea</i> Som	Prune cythère (F)	Anacardiaceae	+
<i>Spondias mombin</i> L.	Mombin (F)	Anacardiaceae	+
<i>Strychnos cocculoides</i> Baker	Makalakonki (K)	Loganiaceae	++
<i>Syzygium malaccense</i> (L.) Merr. & L.M.Perry	Pomme rose (F)	Myrtaceae	+
<i>Vitis vinifera</i> L.	Raisin (F)	Vitaceae	+

Note: (L), Lingala; (K), Kikongo; (F), French; (+), Less frequent; (++), Frequent; (+++), More frequent.

Figure 3. Some fruits found in four markets of Mont-Ngafula township, Kinshasa City: **A**, *Aframomum alboviolaceum*; **B**, *Ananas comosus*; **C**, *Annona muricata*; **D**, *Carica papaya*; **E**, *Citrullus lanatus*; **F**, *Citrus limon*; **G**, *Citrus reticulata*; **H**, *Citrus sinensis*; **I**, *Cola acuminata*; **J**, *Dacryodes edulis*; **K**, *Elaeis guineensis* (Inset showing pulp of fruits); **L**, *Garcinia mangostana*; **M**, *Malus domestica*; **N**, *Mangifera indica*; **O**, *Musa paradisiaca*; **P**, *Nephelium lappaceum*; **Q**, *Persea americana*; **R**, *Syzygium malaccense*.

It was observed that in February presents a greater variety of fruits than the month of June. It should also be noted that papaya, banana, coconut and apples were present from January to June while mangosteens, fewer passion fruits, rambutan and pink apples were only present in January and February.

Characteristics of vendors activities

Commercial activity: To understand the commercial activity taking place in different markets surveyed is necessary because it allows knowing if these vendors sell only fruits or fruits along with other products (Table 3).

Table 2. General situation of fruits seasonality for six months.

January	February	March	April	May	June
Pineapple	Pineapple	Pineapple	Pineapple	Pineapple	Banana
Avocado	Avocado	Avocado	Avocado	Avocado	Plantain
Banana	Banana	Banana	Banana	Banana	Custard apple
Plantain	Plantain	Plantain	Plantain	Plantain	Lemon
Custard apple	Custard apple	Custard apple	Lemon	Lemon	Mango
Mangosteen	Lemon	Lemon	Coconut	Orange	Apple
Mango	Mango	Grape-seeded amomum	Papaya	Apple	Coconut
Passion fruit	Passion fruit	Orange	Orange	Coconut	Tangerine
Coconut	Mangosteen	Coconut	Coconut	Watermelon	Orange
Kola nut	Kola nut	Papaya	Tangerine	Papaya	Papaya
Papaya	Coconut	Tangerine	Grapefruit	Tangerine	Watermelon
Watermelon	Palm nut	Grapefruit	Apple	Bush butter tree	Grapefruit
Rambutan	Rambutan	Orange	Mango	Grape-seeded amomum	Carambola
Apple	Apple	Apple	Grape-seeded amomum	Grapefruit	
Bush butter tree	Red apple	Watermelon	Carambola	Mango	
	Watermelon				
	Grapefruit				
	Golden apple				
	Papaya				
	Bush butter tree				

Table 3. Commercial activity.

Commercial Activity	Frequency	Percentage
Sale of fruits exclusively	32	100
Sale of fruits and other products	0	0
Total	32	100

It can be observed from the above table that 100% of fruit vendors sell exclusively fruits and they don't sell any other products than fruits.

Duration in the activity: The duration in the activity explains the time that the respondents spent in this activity. The distribution following the duration of vendors' activity is presented in figure 4.

Figure 4. Duration of activity in selected markets.

As shown in the above figure, a large majority of vendors were in this activity for more than 10 years as observed at Matadi-Kibala market (70%), Cité-Pumbu market (53.8%) and Masanga-Mbila market (37.5%) except for the UPN market where a proportion of 21% was found for this category. The UPN market was dominated by vendors (31.3%) having an experience of less than 5 years in exerting this activity. This explains the deterioration of socio-economic conditions that are driving many people into the informal commercial sector for their survival.

Storage method: This allows to determine how various fruits identified are preserved from the purchase to sale.

Some fruits are still immature at the time of purchase and are preserved so that they can ripe at the time of

sale (Fig. 5).

Figure 5. Storage method of fruits sold in selected markets.

The figure above gives the distribution in the set of fruits according to their preservation method. It shows that that most of fruits sold in these markets are preserved in the bag (UPN market, 28.1%; Matadi Kibala market, 70%; Cite Pumbu market, 46%; Masanga Mbila market, 37.5%). Meanwhile, a smaller portion of these fruits are kept in the plastic bag as follows: 3.1%, (UPN); 10%, (Matadi Kibala), 2%, (Cite Pumbu) and 6.3% (Masanga Mbila). Fruits cannot be stored for a long time for fear that they will rot.

It should be noted that some fruits such as safou and cola nuts have special preservation methods that are not mentioned in the figure above. Safou are sensitive to heat that is why they are kept outdoors while cola nuts prefer humidity, thus they are buried to be well preserved. Bananas, Plantains and papaya can also be stored in the open air but the only problem with this method is that it takes longer.

Duration of fruit conservation: The duration of fruit conservation sold in selected markets is given in figure 6 below.

Figure 6. Time of conservation of fruits sold in selected markets.

From the above figure, it is clearly shown that a large proportion of fruit is stored in less than 5 days distributed as follows in different markets respectively: UPN (40.6%), Matadi-Kibala (90%), Cité Pumbu (80%) and 56.6%, Masanga-Mbila market (56.6%). Fruits kept for less than 2 days have a high proportion in the UPN market (40.6%) as well.

Source of fruit: During the 6-month survey period, a question was asked to the vendors about the origin of fruit sold. In general, these fruits originate from the province of Kongo Central which is the nearest province to

Kinshasa city especially to Mont-Ngafula township.

Availability of fruits in selected markets

The availability of fruits in selected markets is presented in tables (4–7) below.

Table 4. Distribution of available fruits per month at UPN market.

SN	Fruits	January	February	March	April	May	June
1	African Eggplant	+	+	+	+	+	+
2	Avocado	+	+	+	+	+	+
3	Banana	+	+	+	+	+	+
4	Bush butter tree	+	+	+	-	-	-
5	Carambola	-	-	-	+	+	+
6	Coconut	+	+	+	+	+	+
7	Congo rubber	+	+	-	-	-	-
8	Custard apple	+	+	+	-	-	+
9	Golden apple	+	+	-	-	-	-
10	Grape	-	-	-	-	-	-
11	Grapefruit	-	-	+	+	+	-
12	Green/red apple	+	+	-	-	-	-
13	Guava	-	-	-	-	-	-
14	Kola nut	+	+	-	-	-	-
15	Lemon	-	-	+	+	+	-
16	Mangosteen	+	+	+	-	-	-
17	Meleguette	-	-	+	+	+	-
18	Orange	-	-	+	+	+	-
19	Papaya	+	+	+	+	+	+
20	Passion fruit	-	-	+	+	-	-
21	Pear	-	-	-	-	-	-
22	Pineapple	+	+	+	+	+	+
23	Plantain	+	+	+	+	+	+
24	Rambutan	+	+	-	-	-	-
25	Tangerine	-	-	+	+	+	-

Note: (-), Absent in the market; (+), Present in the market.

Table 5. Distribution of available fruits per month at Matadi-Kibala market.

SN	Fruits	January	February	March	April	May	June
1	African Eggplant	-	-	-	-	-	-
2	Avocado	-	-	-	-	-	-
3	Banana	+	+	+	+	+	+
4	Bush butter tree	-	-	-	-	-	-
5	Carambola	-	-	-	-	-	-
6	Coconut	+	+	+	+	+	+
7	Congo rubber	-	-	-	-	-	-
8	Custard apple	-	-	-	-	-	-
9	Golden apple	-	-	-	-	-	-
10	Grape	-	-	-	-	-	-
11	Grapefruit	-	-	+	+	+	-
12	Guava	-	-	-	-	-	-
13	Kola nut	-	-	-	-	-	-
14	Lemon	-	-	+	+	+	-
15	Mangosteen	-	-	-	-	-	-
16	Meleguette	-	-	-	-	-	-
17	Orange	-	-	+	+	+	-
18	Papaya	-	-	-	-	-	-
19	Passion fruit	-	-	-	-	-	-
20	Pear	-	-	-	-	-	-
21	Pineapple	+	+	+	+	-	-
22	Plantain	+	+	+	+	+	+
23	Rambutan	-	-	-	-	-	-
24	Red/Green apple	-	-	-	-	-	-
25	Tangerine	-	-	+	+	+	-

Note: (-), Absent on the market; (+), Present on the market.

Table 6. Distribution of available fruits per month at Cité-Pumbu market.

SN	Fruits	January	February	March	April	May	June
1	African Eggplant	-	-	-	-	-	-
2	Avocado	-	+	-	-	-	-
3	Banana	+	+	+	+	+	+
4	Bush butter tree	+	+	+	-	-	-
5	Carambola	-	-	-	-	-	-
6	Coconut	-	-	-	-	-	-
7	Congo rubber	+	+	-	-	-	-
8	Custard apple	-	-	-	-	-	-
9	Golden apple	+	+	-	-	-	-
10	Grape	-	-	-	-	-	-
11	Grapefruit	-	-	+	+	+	-
12	Green or red apple	-	-	-	-	-	-
13	Guava	-	-	-	-	-	-
14	Kola nut	-	-	-	-	-	-
15	Lemon	-	-	+	+	+	-
16	Mangosteen	+	+	+	-	-	-
17	Meleguette	-	-	+	+	+	-
18	Orange	-	-	+	+	+	-
19	Papaya	-	-	-	-	-	-
20	Passion fruit	-	-	-	-	-	-
21	Pear	-	-	-	-	-	-
22	Pineapple	+	+	+	+	-	-
23	Plantain	+	+	+	+	+	+
24	Rambutan	+	+	-	-	-	-
25	Tangerine	-	-	+	+	+	-

Note: (-), Absent on the market; (+), Present on the market.

Table 7. Distribution of available fruits per month at Masanga-Mbila market.

SN	Fruits	January	February	March	April	May	June
1	African Eggplant	-	-	-	-	-	-
2	African pear	+	+	+	-	-	-
3	Avocado	+	+	-	-	-	-
4	Banana	+	+	+	+	+	+
5	Carambola	-	-	-	-	-	-
6	Coconut	-	-	-	-	-	-
7	Congo rubber	+	+	-	-	-	-
8	Custard apple	-	-	-	-	-	-
9	Golden apple	+	+	-	-	-	-
10	Grape	-	-	-	-	-	-
11	Grape fruit	-	-	+	+	+	-
12	Guava	-	-	-	-	-	-
13	Kola nut	-	-	-	-	-	-
14	Lemon	-	-	-	-	-	-
15	Mangosteen	+	+	-	-	-	-
16	Meleguette	-	-	-	-	-	-
17	Orange	-	-	+	+	+	-
18	Papaya	-	-	-	-	-	-
19	Passion fruit	-	-	-	-	-	-
20	Pear	-	-	-	-	-	-
21	Pineapple	+	+	+	-	-	-
22	Plantain	+	+	+	+	+	+
23	Rambutan	+	+	-	-	-	-
24	Red or green apple	+	+	-	-	-	-
25	Tangerine	-	-	+	+	+	-

Note: (-), Absent on the market; (+), Present on the market.

From the table 4, it is clearly shown that only six fruits were present on the UPN market. These include African Eggplant, Avocado, Banana, Coconut, Pineapple and Plantain. While the others were present for only a few months, hence their seasonality. Table 5 reveals that some fruits were present at the Matadi-Kibala market during all the six months of the survey namely Banana, Coconut and Plantain. Compared to the UPN market,

there are many fruits missing at this market. This may be due to the quality of the customer base found in this market. In the market of Cité-Pumbu only two fruits are present throughout the six months *i.e.* Banana and Plantain (Table 6). This also proves that the clientele is not interested in fruits, hence the lack of interest of vendors to devote themselves to this activity. The market of Masanga-Mbila also has only two fruits (Banana and Plantain) for the six months (Table 7).

The almost same situation in the markets of Matadi-Kibala, Cité-Pumbu and Masanga-Mbila shows that customers of these markets do not have much interest in fruit consumption. These results do not prove that the fruits are absent, since they are found in the UPN market, but they only prove the quality of the present customer base, which is that UPN vendors have a different customer base than three other markets.

DISCUSSION

NWFPs remains one of the main sources of food, medicine and income for rural and urban populations in Central Africa. However, different approaches namely the study of marketing and sustainable management have been used in sub-tropical Africa, Asia and America. There are various approaches used for the exploitation of NWFPs, and our focus was on the ethnoecology approach. This survey showed us that the sale of fruits is more exercised by women than men. However, it emphasizes that in production areas, men are responsible for the production of annual and perennial crops; while women are content to practice annual crops. It should be noted that women are increasingly interested in the collection of NWFPs and especially fruits that bring back substantial income for the household. Men are found in the middle links: (Matadi Kibala, 20% and Masanga Mbila, 25%). It was noted a total absence of men at the UPN and Cite Pumbu markets. This leads to the conclusion that fruit harvesting and retailing are the responsibility of women rather than men. This is because collecting just like retail requires a lot of time that men are not ready to spend. These findings are similar to Biloso (2006) who reported that 49.3% of the heads of households surveyed are men while 50.7% are women.

It is clear that the fruit trade is a function of the vendor marital status. Married people have significant social security contributions, hence the need to resort to an income-generating activity. These results resemble those of Biloso (2006) in valuing NWFPs which show that farmers living together with their partner represent the largest class of farmers (74% to 82.1%), it is evident that the exploitation of NWFPs is a function of the marital status of the farmer. This finding is consistent with Biloso & Lejoly (2006) reported that there were more women than men in the performance of this activity.

Concerning the diversity of fruits, this survey identified twenty-nine different fruits belonging to 23 families dominated by Anacardiaceae and Rutaceae families. These results are consistent with Kouebou *et al.* (2013) who identified about twenty fruits on sale belonging to 14 families dominated by *Rutaceae* (citrus fruits).

Regarding the frequency of fruit on the market, the findings of this survey showed that banana, plantain, papaya, coconut are the most common because they appear for six months while citrus fruits become common from March. There is a diversity of fruits in the UPN market while in other markets surveyed (Cité Pumbu, Matadi Kibala and Masanga Mbila), it was observed that the sale of fruits is selective such as: bananas, plantain, coconut (all year), pineapple (January–May) and citrus (March–June).

CONCLUSION

Preliminary observations were initiated at the Department of Biology to assess the biodiversity of different fruits sold in Kinshasa markets and their seasonality. Twenty-nine fruits were inventoried in UPN, Matadi-Kibala, Cité Pumbu and Masanga Mbila markets between January and June 2016. The major groups of these fruits come from Kongo Central province which is the nearest province of Kinshasa city. They belong to twenty-three botanical families dominated by Anacardiaceae and Rutaceae families.

The findings of this study showed that more women are interested in selling fruits than men; while the permanent presence of plantain, banana, papaya and watermelon on the market during the six months of the survey, followed by citrus fruits (lemon, orange, grapefruit and mandarin) which appear from the third month of the year, followed by the disappearing of safou and rambutan, found more in the first two months *i.e.* January and February, while in June appears the carombola. These fruits are kept in various ways from purchase to sale. The sale of fruits is an old activity for the majority of the respondents and it was showed in the time that vendors have spent in this activity. Knowing that the sale of fruits is a very profitable activity, it allows the vendors to provide to their own needs and the one of their families. Considering the Congolese vegetal biodiversity, all these elements are important for they serve as the basis for the development of a research strategy for the promotion of fruit resources in DRC.

ACKNOWLEDGEMENTS

We express our gratefulness to the GBIF (Congo Democratic Biodiversity Information Facility) for its support to the realization of this research as well as to the Laboratory of Systematic Botany and Plant Ecology, Department of Biology, Faculty of Sciences for the identification of species.

REFERENCES

- Adebawo O, Salau B, Ezima E, Oyefuga O, Ajani E, Idowu G, Famodu A & Osilesi O (2006) Fruits and vegetables moderate lipid cardiovascular risk factor in hypertensive patients. *Lipids in Health and Disease* 5: 14.
- Biloso A (2006) Exploitation et marché des Produits Forestiers Non Ligneux : Cas de la fougère (*Pteridium centrali-africanum* Hieron.) à Kinshasa, *Gepac Newsletter* n°8, Université Libre de Bruxelles (Belgique), 4 p.
- Biloso A & Lejoly J (2006) Etude l'exploitation et du marché des produits forestiers non ligneux à Kinshasa. *Tropicultura* 24(3) :183–188.
- Dhandevi PEM & Jeewon R (2015) Fruit and Vegetable Intake: Benefits and Progress of Nutrition Education Interventions: Narrative Review Article. *Iran Journal of Public Health* 44(10): 1309–1321.
- FAO (2001) Le rôle de la diversité biologique dans l'alimentation de l'humanité.
- Kouebou C, Fadi G, Bourou S, Djakissam PK, Layla H, Zenabou G, Barbi M, Vunyingah M & Woin N (2013) Biodiversité et valeur alimentaire des fruits au Cameroun: Observations préliminaires dans le Département de la Bénoué (Région du Nord). *Journal of Applied Biosciences* 69: 5510–5522.
- Merlin (2012) Manger le fruit avec l'estomac vide l'estomac vide. 37 p.
- Muraki I, Imamura F, Manson JE, Frank BH, Willett WC, Dam RMvan & Sun Q (2013) Fruit consumption and risk of type 2 diabetes: results from three prospective longitudinal cohort studies. *British Medical Journal* 347: f5001.
- Ndjebe NC (1997) *Spatial distribution of non timber forest product collection, (a case study of South Cameroon)*. Wageningen Agricultural University (department of forestry), 65 p.
- Park HM, Heo J & Park Y (2011) Calcium from plant sources is beneficial to lowering the risk of osteoporosis in postmenopausal Korean women. *Nutrition Research* 31: 27–32.
- Payne ME, Steck SE, George RR & Steffens DC (2012) Fruit, Vegetable, and Antioxidant Intakes Are Lower in Older Adults with Depression. *Journal of the Academy of Nutrition and Dietetics* 112: 2022–2027.
- Sene A (2001) *Exploitation et valorisation des produits forestiers non ligneux dans la région de Kolda : Caractérisation des acteurs de base*. Convention ISRA, BAME et UICN, Dakar.
- Tchatat M, Ndoeye O & Nasi R (1999) *Produits forestiers autres que le bois d'oeuvre (PFAB) : Place dans l'aménagement durable des forêts denses humides d'Afrique Centrale*. FORAFRI, pp. 94.
- Combe J (1982) Agroforestry techniques in tropical countries: potential and limitations. *Agroforestry Systems* 1: 13–27.
- Tollens E (2003) *L'Etat Actuel de la Sécurité Alimentaire en R.D. Congo : Diagnostic et Perspectives, Working Paper 277*. Département d'Economie Agricole et de l'Environnement, Katholieke Universiteit Leuven, pp. 48.