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Nutritional potentials of *Cucumeropsis edulis* (Hook. f.) Cogn seeds and the pulp of *Adansonia digitata* L. from Burkina Faso: Determination of chemical composition and functional properties

[1*]Savadogo, A., [1]Zongo, C., [2]Bayala, B., [1]Somda, K. M. and [1]Traoré, A. S.

[1]Laboratoire de Microbiologie et de Biotechnologie, Centre de Recherche en Sciences Biologiques, Alimentaires et Nutritionnelles(CRSBAN). Département de Biochimie-Microbiologie (DBM) ; Unité de Formation et de Recherche en Sciences de la Vie et de la Terre (UFR/SVT) ; Universite de Ouagadougou
[2]University of Ouagadougou. Formation and Research Unit in Life and Earth Science. Laboratory of Animal Physiology. 03 BP 7021 Ouagadougou 03 (Burkina Faso)

Abstract: *Cucumeropsis edulis* seeds from six small markets of Ouagadougou and six samples of *Adansonia digitata* pulp products from two towns (Bobo and Ouagadougou) were subjected to chemical composition and functional properties analyses. The proximate content of *Cucumeropsis edulis* seeds included moisture (varies from 3.81 to 4.76% of fresh matter), total ash (varies from 3.26 to 4.05%), carbohydrates (varies from 14.08 to 16.43% of fresh matter), proteins (varies from 27.02 to 27.66% of fresh matter), crude fat (from 44.8 to 51.1% of fresh matter). The result show good nutritional composition of *Cucumeropsis edulis* seeds. The proximate content of *Adansonia digitata* pulp products moisture (varies from 6.81 to 10.32% of solid product), total ash (varies from 1.21 to 4.80% of solid product), carbohydrates (varies from 11.40 to 13.62% of fresh matter), proteins (varies from 0.26 to 1.06 % of solid product), fat (from to 0.40% to 0.94% of fresh matter), Vitamin C (varies from 43 mg/100 g to 1340 mg/100 g of the product), Acidity (varies from 0.68 g/100 ml to 3.35 g/100 ml).

Keywords: *Cucumeropsis edulis*, *Adansonia digitata*, nutritional potentials, functional properties

Introduction

Cucumeropsis edulis is a yearly, rampant or trailing plant of more than three meters of long, clinging by its gimlets rowers. *Cucumeropsis edulis* member of *Cucurbitaceae* family is a variety of melon seeds, which is a creeping annual plant and an intercropping plant made use of in traditional farming practices, thrives well on rich light soil in the hot climatic regions of Africa. It is a cultivated plant, in the countries has hot climate, however, and has been noted to tolerate low rainfall (Cobley, 1957). Contrary to the other species of the family of the *Cucurbitaceae, Cucumeropsis edulis* plant is widely cultivated for their seeds, which have high content of fat and protein. *Cucumeropsis edulis* seeds can be obtained either in shelled or unshelled forms in West African markets and are used greatly in West African cookery.

It is known under several vernacular names: *egusi* (Golf of Guinea), *sara-dè* (*djoula*, Burkina Faso), *niri* (*mooré*, Burkina Faso). The seeds of the *Cucumeropsis edulis* present themselves under the whitish color, of oval and flat shape. In Burkina Faso, its culture is not developed, it is practiced on reduced surfaces or cultures in slot in some such regions the region named "*boucle du Mouhoun*", the region of the high basins and the region named "*Cascades*" by some groups of ethnic groups: the "*gouins*", the "*dagaris*", the "*lobis*" and the "*dafings*". The seeds of the *Cucumeropsis edulis* are part of these condiments capable to enter in the preparation of some of these sauces in Burkina Faso. They are consumed crushed indeed or grilled and serve to thicken sauces. One sometimes makes a cake of it cooks steam or under shapes of wads in sauces.

Adansonia digitata L. is a very old fruit-producing tree, belonging to the family of the *Bombacaceae* ; the fruit of parts of the plant are used in as food (seeds ,fruit pulp, leaves) as beverage (juice of fruit pulp) and in medicinal purposes (leaves, seeds, roots). The pulp is used as febrifuge, analgesic, antipyretic, anti-diarrhea, anti-dysentery and treatment of haemoptysis and measles (Ramadan *et al*., 1994; Tal-Dia *et al*., 1997). Leaves bark and fruits of *Adansonia digitata* L. are used in several regions as foodstuffs and for medicinal purposes (Etkin and Ross, 1982; Kerharo and Adam, 1974). *Adansonia digitata* L. has nutritional properties (Obizoba and Anyika, 1994; Lockett *et al*., 2000). The *baobab* can be also very useful to the man : fresh or dried leaves, transformed in flour are used for sauce of cereal food; the pulp of its fruits as well as its seeds are very nourishing, because they contain many trace elements and vitamins. The leaves have tried medicinal virtues.

Adansonia digitata from tropical Africa where

*Corresponding author.
Email: *aly.savadogo@univ-ouaga.bf, alysavadogo@gmail.com*
Tel/Fax: (226)50 33 73 73

it is characterized the landscape of the steppes and savannas. This tree provides food, shelter, clothing, medicine, material for hunting and and fishing (Venter and Venter, 1996). The fruit ovoid, named "*Bread of monkey"* in French, "*Teddo*" in *mooré* (local language), contains black seeds coated of a white chalky pulp. The name "*Bread of monkey*" derived from the fact that monkeys eat more the fruit (Rashford, 1994). The pulp of fruit is consumed extensively in a traditional way under different shapes. There are limited informations on the physicochemical and proximate composition of the *Cucumeropsis edulis* seeds and the pulp of *Adansonia digitata* L. fruit. This survey appears in the setting of the valorization of the local products.

Materials and Methods

Sampling

Samples of fresh seeds of *Cucumeropsis edulis* were purchased from six small markets of Ouagadougou (Burkina Faso) in June 2009: M1 (zone 1 market), M2 (zogona market), M3 (wayalghin market), M4 (Nabi-yaar market), M5 (dassasgho market) and M6 (Sankar-yaar market). Six samples of A. digitata pulp products were purchased from Ouagadougou and Bobo-Dioulasso of which three (3) in powder with one (1) in wild state that we shelled, separated of the seeds and fibers, one (1) juice and one (1) solid, under shape cake (Table 1). The collected seeds samples of *Cucumeropsis edulis* were identified in Laboratory of Botany and Ecology at the University of Ouagadougou. The samples were dried and directly crushed and the corresponding flours sieved through a sieve of porosity of 1 millimeter for physical and chemical analysis.

Table 1. Characteristics of *Adansonia digitata* pulp products samples

Samples Code	The nature of the samples	Place of sampling
E1	in powder	Ouaga (Zogona)
E2	in powder	Ouga (Larlé)
E3	in powder	Bobo (Nieneta)
E4	Solide (under shape cake)	Ouaga (Larlé)
E5	pulp	Ouaga (Zogona)
E6	juice	Ouaga

Physical and chemical analysis

Determination of the moisture

The level of moisture was estimated by desiccation with the drying oven at 103°C (method 925-10, AOAC, 1990).

Ash analysis

The ash content was estimated by incineration with the furnace at 550°C (method 923-03, AOAC, 1990).

Determination of the fat content

The determination of the fat content is made according to the method of extraction by the soxhlet Aa 4-38 (AOCS, 1990) by using hexane as solvent.

Proteins analysis

Nitrogen was determined using the Kjeldahl method (Matissek *et al*., 1989). The quantity of protein was calculated as 6.25×N (AOCS, 1990).

Carbohydrates analysis

The content of total carbohydrates was determined by difference (Egan *et al*., 1981) according to the formula:

H.C (%) = 100 – [% water + % proteins + % lipids + % ashes]

H.C represented carbohydrates content.

Starch analysis

The dosage of the starch was carried out according to the fast spectrometric method described by Jarvis and Walker (1993).

Calculation of the energy value

The theoretical energy value of the seeds was calculated starting from the analytical values for total protein, the fat content, the carbohydrates (including crude fibers) using the values of physiological energy deferred by Paul and Southgate (1985) according to the formula :

E (kJ) = 17 (kJ / G) x% total protein + 38 (kJ / G) y% fat content + 17 (kJ / G) z% carbohydrates

This Energy was estimated for 100 g of Sample. Conversion into Kcal/g was carried out by multiplication by 4.184.

Stability of A. digitata *pulp*

In order to value the stability of the pulp and the impact of the storage on it quality, the evolution of it composition during a storage to ambient temperature (30°C) has been followed during 35 days. They were conditioned in non insulated plastic pockets of white color to constant temperature of 37°C. Some codes will be assigned to these samples for the purpose of the survey.

Results and Discussion

The moisture

The water content of our *Cucumeropsis edulis* seeds samples varies from 3.81 to 4.76% of fresh matter (Table 2). These different contents are below those already returned by Agbessis and Damon (1986), and those obtained by Akpambang *et al*. (2008). These results can be bound and due to fact of the harvest period, the length of storage of the product (humidity of air and the temperature). The seeds of the *Cucumeropsis edulis*, due to their weak wealth in water are therefore safe for possible bacteriological change which needs water content more than 14%. We notice that of the content in water of all the samples of *Adansonia digitata* pulp varies from 6.81 to 10.32%. The sample E2 was the most moist and the least moist was sample E4 (Table 4). These values obtained were similar to those obtained by Diop (2005).

Table 2. Macro molecules proximate composition and Energy value of *Cucumeropsis edulis* seeds

Parameters	Samples compositions (%)					
	M1	M2	M3	M4	M5	M6
Moisture	4.42	4.54	3.81	3.87	4.76	4.28
Dry matters	95.58	95.46	96.19	96.13	95.24	95.72
Protein	27.66	27.33	27.02	26.7	26.79	27.23
Lipid	44.8	48.3	50.1	49.82	47.82	49.9
Carbohydrate	16.43	15.64	14.86	14.08	14.86	15.04
Starch	10.25	12.16	9.72	9.03	10.77	11.46
Energy (Kcal 100 g)	554.84	592.66	597.86	591.3	580.62	603.36

The carbohydrates

The carbohydrates content of our *Cucumeropsis edulis* seeds samples varies from 14.08 to 16.43% (Table 2). Compared to values of FAO (1970, 1998) databases, our results are located in the same interval; but below those obtained by Duke (1978). The carbohydrates are more to bring the fuel of the organism like glucose. The contribution of the carbohydrates to the energy in a food ration recommended by the WHO (1990) is from 55 to 75%. The starch represents close to 62.3 to 64.13% of the rate of the carbohydrates of our *Cucumeropsis edulis* seeds samples.

The carbohydrates content of *Adansonia digitata* pulp samples varies from 11.40 to 13.62%.The main Function of carbohydrates is to provide your body with energy and Carbohydrates contain about 4 calories per gram. Generally carbohydrates are divided into 2 groups: simple and complex. Complex carbohydrates include fiber and starch are found in vegetables.

The proteins

The proteins content of the *Cucumeropsis edulis* seeds samples varies from 26.70 to 27.66% (m/m) (Table 2). Akpambang *et al*. (2008) reported 31.85% of protein in *Cucumeropsis edulis* from Nigeria. These results are the same order of size that those already obtained by Agbessi and Damon (1986); but on the other hand below to those obtained by Akpambang *et al*. (2008).

The proteins content of the *Adansonia digitata* pulp samples is consisted between 0.26 and 1.06% with sample E1 as the sample containing more proteins (Table 4). These values are below to those obtained by Nour *et al*. (1980) with samples of *Adansonia digitata* from Khartoum (Sudan). Protein contributes to the formation of hormones which controls a variety of body functions such as growth, repair and maintenance of body (Mau *et al*., 1999).

Proteins are necessary for body building and cells replacement. To this subject, the daily recommendations in proteins underlined by the WHO (1990) are from 14.5 to 53.3% of ration for men and women. The protein containing essential amino acids have high nutritional values therefore they are suitable for consumption. The seeds of the *Cucumeropsis edulis*, with their strong content in proteins position themselves like a regulating factor to this need. Proteins are composed of different amino acids. Twenty amino acids are necessary to construct all vitamins. The body knows to manufacture 12 of it, the 8 others are only brought by food, from where their qualification of essential amino acids. The most recognized food for their quantitative and qualitative contribution in proteins is the products of animal origin and fish. The legumes, as regards to their composition in proteins are in general compared at last.

Fat content

In our *Cucumeropsis edulis* seeds samples, the content in fat varies from 44.8 to 51.1% of fresh matter (Table 2). These contents are the same order of size that those returned by Agbessi and Damon (1986) and of those of Duke (1978). In relation to the daily energy in a food ration, the lipids represent 15 to 30% of this energy for the adults (WHO, 1990). The cereals contain some contents in lipids going from 6.2 to 10.24% (Ouattara *et al*., 2006); these contents are below to those of our *Cucumeropsis edulis* seeds samples.

The fat content of our *Adansonia digitata* pulp samples is consisted between 0.40 and 0.94% with sample E2 as the one containing highest quantity (Table 4). These values are superior to those obtained by Nour *et al*. (1980). African population use *Adansonia digitata* pulp as famine food to prepare decoctions, sauces and refreshing drink due to its

nutritional properties (Lockett *et al*., 2000).

The lipids are excellent energizing food; either contributes 9 kcal/g. In regions where cereals represent the main part of food, supplementations by others food rich in lipids are needed. The seeds of the *Cucumeropsis edulis* that contain a high rate in lipids position themselves in better compensatory for this need. Their wealth in polyunsaturated fatty acids also made them important in membrane cholesterol regulation and reduces the rate of cholesterol in serum (Karleskind, 1992). According to all these advantages, the consumption of the seeds of the *Cucumeropsis edulis* is to counsel; especially for the vulnerable populations.

Minerals and vtamins C content of Cucumeropsis edulis *seeds and* Adansonia digitata *pulp*

The mineral content of *Cucumeropsis edulis* is presented in Table 3. The total minerals (ash) content varies from 3262 to 4050 mg/100 g. The calcium content varies from 39 to 45 mg/100 g. The concentration in magnesium varies from 139 to 152. 1.65 mg/100 g and 1.05 mg/100 g were reported for calcium and magnesium respectively in *Cucumeropsis edulis* seeds from Nigeria (Akpambang *et al*., 2008). The ash and Vitamin C content of *Adansonia digitata* pulp are presented in Table 4. The ash content varies between 0.10 to 4.80%. The mineral content is high for the sample E1 product (4.80%) and low for the E6 (0.10%) sample which is in juice form. The Vitamin C content varied between 43 mg/ 100 g to 1340 mg/100 g. These values indicate that *Adansonia digitata* pulp is an important source of Vitamin C. The fruit of *Adansonia digitata* contents more Vitami C than orange, and more calcium than cow's milk. *Adansonia digitata* pulp powder was used in addition to tempe in order to give the characteristic aroma and acidic taste by the local people of Nigeria (Afolabi and Popoola, 2005).

Table 3. Mineral composition of *Cucumeropsis edulis* seeds

Parameters	Samples compositions (mg/100g)					
	M1	M2	M3	M4	M5	M6
Total ash (mg)	3370	3260	3302	3440	4050	3700
Calcium (mg)	45	39	42	45	45	45
Magnesium (mg)	147	139	150	152	150	149

Vitamins and mineral are essential for normal growth; metabolism and can influence the well utilization or assimilation of other nutrients (proteins, carbohydrates, lipids). These compounds are essential for good health. Deficiency of minerals and essentials vitamins can lead to physiological disorders and diseases. In this order of idea complex-B vitamins groups is necessary for proteins assimilation. Low enzymatic activity and poor electrolyte balance in blood are related to inadequate or deficiency of sodium (Na), potassium (K), magnesium (Mg) and Zinc (Zn) in cells. According to Ramadan *et al*.(1994) the analgesic and antipyretic activities of *Adansonia digitata* pulp may be due to the presence of sterols, saponins and triterpenes.

Energy value of Cucumeropsis edulis *seeds and* Adansonia digitata *pulp*

The energy value of *Cucumeropsis edulis* seeds samples are ranged between 554.84 Kcal/100 g to 603.36 Kcal/100 g. These values are high. Cucumeropsis edulis seeds are rich in lipids, this fact can explain why many group of people used it us energizing food according to the literature. Food investigations done in many countries of Africa have shown a weak consumption of food rich in lipids. Indeed, the lipids represent 10 to 20% of the total of the food calories. Besides their protective and energizing role, the lipids are indispensable to transport in the organism the soluble vitamins in the greases.

The appreciation of the energy value made in isolation didn't interest on the nutritional plan. It is recognized since strong decade that the metabolism of the proteins is influenced by the energy contribution. The energy that the organism uses essentially comes from the oxidization of the digestible carbohydrates, of the lipids and incidentally the proteins. It is necessary to grant a particular attention therefore to the Protein/Energy contributions and to the proportions of energies brought respectively by the carbohydrates, the lipids and the proteins.

Stability of Adansonia digitata *pulp*

The content in water of the *Adansonia digitata*

Table 4. Macro molecules proximate composition of *Adansonia digitata* pulp products samples

Samples	Moisture (%)	Acidity (g/100ml)	Vit C (mg/100g)	Ash (%)	Fat (%)	Carbohydrates	Proteins (%)
E1	7.22	2.35	253	4.80	0.78	11.45	1.06
E2	10.32	2.32	468	4.15	0.94	11.46	0.80
E3	7.52	2.30	128	4.70	0.52	11.41	0.46
E4	6.81	0.68	43	1.21	0.49	11.4	0.31
E5	7.81	2.21	85	3.47	0.40	11.61	0.26
E6	81.5	3.35	1340	0.10	0.40	13.62	0.31

pulp increases during the storage of 80%. The content in vitamin C decreases about 75%. This reduction probably results from an oxidative deterioration of the ascorbic acid. An increase of the titrable acidity of the pulp is also noted of 50%.

Conclusion

This present work revealed that *Adansonia digitata* pulp and *Cucumeropsis edulis* seeds contain essential nutrients for human good health. The *Adansonia digitata* pulp is important food and contains tartaric acid, ascorbic acid, citric acid, malic acid. Different monomeric sugar was identified in the *Adansonia digitata* pulp as raffinose, galactose, sucrose, glucose and fructose. This study revealed the potential of *Cucumeropsis edulis* seeds respectively in proteins, lipids, calcium and magnesium. It is therefore necessary to encourage their production for a more disponibility, but also to promote their consumption by the population who usually uses these foods for their nutritive value but for their taste.

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