American Journal of BioScience
2013; 1(4): 74-79
Published online November 20, 2013 (http://www.sciencepublishinggroup.com/j/ajbio)
doi: 10.11648/j.ajbio.20130104.14

Comparative study of proximate chemical composition of two varieties of okra dried by two methods: sun and electric drying

Joel Brice Kouassi[1], Cisse-Camara Massara[1], Absalom Ake Monde[1], Georges Gnomblesson Tiahou[1], Daniel Essiagne Sess[1], Etienne Tia vama[2]

[1]Laboratory of Biochemistry, Medical Sciences Faculty, University Felix Houphouet Boigny Abidjan, 01 BP 240 Abidjan, Ivory Coast
[2]Laboratory industrial synthesis processes of the environment and new energy (LAPISEN) of the National Polytechnic Institute Felix Houphouet Boigny (INPHB) Yamoussoukro.

Email address:
joelbricekouassi@yahoo.fr (J. B. Kouassi)

To cite this article:
Joel Brice Kouassi, Cisse-Camara Massara, Absalom Ake Monde, Georges Gnomblesson Tiahou, Daniel Essiagne Sess, Etienne Tia vama. Comparative Study of Proximate Chemical Composition of Two Varieties of Okra Dried by Two Methods: Sun and Electric Drying. *American Journal of BioScience*. Vol. 1, No. 4, 2013, pp. 74-79. doi: 10.11648/j.ajbio.20130104.14

Abstract: This study aimed to determine and compare the proximate chemical composition of two varieties of okra dried by two methods: electric and sun drying. After the growing of the two varieties of okra (Baoule and Dioula) at several sites in Yamoussoukro, the fruits of these varieties were harvested randomly at maturity (45 days for Dioula variety and 120 days for the Baoule variety). These fruits were then cut into slices and dried in the sun for 3 weeks and in the oven for 48 h and powdered. The proximate chemical compositions were subsequently determined. The results indicated that the two varieties of dried okra are rich in carbohydrates and proteins with an interesting energy values for both drying methods but higher when drying is done at 60 °C. This study showed that drying is a way of valorization of the okra. Drying at 60°C would be interesting since it induces fewer modifications of the proximate chemical composition of the okras with higher energy values and a shorter time of drying.

Keywords: Proximate Chemical Compositions, Okra, Sun Drying, Electric Drying

1. Introduction

Okra (*Abelmoschus esculentus* and *Abelmoschus caillei*) of Malvaceae family [1, 2, 3, 4] are used daily in households in different forms (fresh fruits, grains, powder) due to their organoleptic qualities and wealth. However, degradation of fresh okra is enhanced by its very high water content (about 88.60 %) [5] Which enhances its physicochemical and microbiological deterioration. The stabilization of okra in order to reduce post-harvest losses and its availability throughout the year is an important issue for the development of the sector. A strategy to reduce losses was developed in Côte d'Ivoire; sun drying is the primary means of preserving agricultural products because of its availability. This activity (drying) helped to develop and promote the chain of okra powder in the sub-region with substantial gains for the industry players. This study compares the proximate chemical compositions of two okra varieties processed by electric and sun drying methods.

2. Materials and Methods

2.1. Biological Material

Two varieties of okra were used: the Baoule variety (not ribbed fruit and less sticky) and Dioula variety (ribbed fruit and sticky) were grown from December 2008 to April 2010 on eighteen (18) different sites in Yamoussoukro distributed six each in three villages; Zatta, Abouakouassikro and Sinzibo. At maturity (green color and firm to the touch) lasting 45 days and 120 days for the Dioula and Baoule variety, respectively, fresh fruits of each variety were harvested at random from each site. Subsequently, fruits of the same variety from the same village were pooled together. In fact, Joel Brice Kouassi et al [6, 7] are reported that both varieties are rich in Iron, Calcium, Copper, Zinc, magnesium, potassium, sodium and manganese.

2.2. Drying Methods

The two okra varieties were dried in the sun and in electric oven. The temperature of 60°C was chosen for the electric drying for 48 hours. In a previous study, this temperature applied to tomatoes reveals it well. For solar drying, the slices of okra were placed on boards are exposed to direct sunlight for three weeks. This drying time was set after interview with producers. After drying, the fruits then pulverized using a mortar and thoroughly homogenized.

2.3. Physicochemical Analysis

The characteristics evaluated after drying included the different families of secondary metabolites; namely alkaloids, polyphenols, tannins, flavonoids, saponins, quinones, sterols or polyterpenes. They were evaluated by a phytochemical screening performed on aqueous extracts of Baoule and Dioula okra varieties according to the method described by Bagre [8]. The ash content was determined according to the method described by Ribereau- Gayon and Peynaud [9]. Lipids were determined by Soxhlet extraction of a sample of 10g, with hexane as solvent. Total protein (N x 6.25) was determined by the method of Kjeldalh [10]. The water content was estimated after drying of 10 g of sample at 103°C in an oven to a constant weight. The estimation of vitamin E content was performed according to Jedlicka et al. [11]. Reducing sugars were measured according to Bernfeld (1955). Total sugars were measured according to the method of Dubois et al. [12]. The contents of total carbohydrate and starch were calculated as recommended by the FAO [13] which takes into account the contents of moisture, fat, protein and ash. The sucrose content was obtained by the difference between the total sugar and reducing sugars present in the sample [14]. The energy value was calculated from the total carbohydrate content, protein and fat using the conversion factors of energy ATWATER: 4 calories per 1 g carbohydrate, 9 kcal per 1 g of fat and 4 kcal per 1 g protein [15]. Crude fiber was determined using the method described by Weende.

2.4. Statistical Data Processing

The data obtained were processed using analysis of variance test (ANOVA 1) followed by Fisher's test using the Statistical Package for Social Sciences SPSS version 18, (Inc., Chicago, IL.). The significance level was set at 5%.

3. Results and Discussion

Tables 1 and 2 show the results of the phytochemical analysis of the sun- and oven-dried okra varieties. They indicate that the varieties of sun-dried okra are rich in catechin tannins and leucoanthocyanes, gallic tannins, sterols and terpenes are low while flavonoids, polyphenols, saponins and alkaloids are either in traces or absent. When these two varieties were dried at 60 °C in the oven, catechin tannins, sterols and terpenes decreased while leucoanthocyanes and gallic tannins were not detected. Other metabolites were either present in traces or absent. The presence of catechin tannins and leucoanthocyanes in the varieties of the dried okra in the sun is very beneficial to human health in the treatment and or prevention of certain diseases. Indeed, sterols and terpenes are endowed with anti -inflammatory activity [16]. Previous studies have demonstrated the antibacterial properties of tannins possessing anti hypertensive properties as flavonoids [17,18,19]. These results show the therapeutic potential of the fruits of these species [20]

Table 1. *Phytochemical components of Baoule and Dioula varieties dried in the sunlight.*

	Baoule variety			**Dioula variety**		
	Zatta	**Abouakouassikro**	**Sinzibo**	**Zatta**	**Abouakouassikro**	**Sinzibo**
Flavonoids	-	-	-	+	+	+
Polyphenols	-	-	-	-	-	-
Saponins	-	-	-	-	-	-
catechic Tanins	+++	+++	+++	+++	+++	+++
gallic Tanins	++	++	++	++	++	++
Leucoanthocyanes	+++	+++	+++	+++	+++	+++
Alkaloids	-	-	-	-	-	-
Sterols and terpenes	++	++	++	++	++	++

(+ + +): Strong presence, (+ +): Low attendance, (+): Traces, (-): NO

Table 2. *Phytochemical components of Baoule and Dioula varieties dried at 60°C in an oven.*

	Baoule variety			Dioula variety		
	Zatta	**Abouakouassikro**	**Sinzibo**	**Zatta**	**Abouakouassikro**	**Sinzibo**
Flavonoids	-	-	-	+	+	+
Polyphenols	-	-	-	-	-	-
Saponins	-	-	-	-	-	-
catechic Tanins	+++	+++	+++	+++	+++	+++
gallic Tanins	++	++	++	++	++	++
Leucoanthocyanes	+++	+++	+++	+++	+++	+++
Alkaloids	-	-	-	-	-	-
Sterols and terpenes	++	++	++	++	++	++

(+ + +): Strong presence, (+ +): Low attendance, (+): Traces, (-): No

Tables 3 and 4 show respectively the proximate chemical compositions of Baoule and Dioula varieties dried in the sun for 3 weeks. Protein levels of the Baoule variety ranging from 17.00 % to 17.15% with an average of 17.15 % while for the Dioula variety the protein varies from 15.75% to 15.77% with a lower average grade of 15.75%. These values are consistent with those reported by Adetuyi et al. [21] and Agbo et al. [22] for Indiana variety. The dried okra can be considered as a vegetable rich in protein compared to Talinum triagulare, Amaranthus hybridus and Celosia Argentia [23]. A significant difference was observed in the 5% threshold for these varieties of okra. The lipid content of the Dioula variety ranged from 2.10 to 2.30 % with an average of 2.17 % and for Baoule variety it was between 1.73% and 2.20 % with a lower average of 2.02 %. No significant difference was observed in the 5% threshold for these varieties of okra. These values are lower than those reported by Adetuyi et al [21] (9.03 to 10.57 %). The mean levels of total and reducing sugars are 20 %, 0.83 % for the Dioula variety and 14.66 %, 0.86 % for the Baoule variety. No significant difference was observed in the 5% threshold for these varieties of okra. The Dioula variety is richer in vitamin E with an average grade of 0.15% against 0.087 % for the Baoule variety. A significant difference was observed in the 5% threshold for these varieties of okra. The average water content is respectively 7.28% and 7.33 % for the Baoule variety and Dioula variety. These values are lower than those proposed by Adetuyi et al. [21] for fresh fruit (87.59 to 90.13 %). These low values observed in the Dioula and Baoule varieties are caused by sun drying. No significant difference was observed in the 5% threshold for these varieties of okra. The ash content, dry matter, starch , sucrose and crude fiber are respectively on the order of 9.20 to 9.80 % , 92.14 to 93.10 % , 39.90 to 47.14 % , 10, 54 to 18.14 % , from 7.58 to 7.96 % for the Baoule variety. For Dioula variety, they are respectively 9.40 to 9.60 %, from 92.30 to 92.90 %, from 40.52 to 40.97 %, from 18.14 to 18.24 %, from 7.76 to 11, 33 %. For these parameters, no significant difference was observed in the 5% threshold for these varieties of okra. The ash and crude fiber of these two varieties corroborate the finding of Adetuyi et al [21] (7.19 to 9.63 % for ash and 10.15 to 11.63 % for crude fiber). Total carbohydrates vary from 63.06 % to 64.38 % with an average of 63.92 % for the Baoule variety against 65.24 % for the Dioula variety which has a total carbohydrate content ranging from 65.03 to 65 %, 53 %. A significant difference was observed in the 5% threshold for these varieties of okra. Thus, dried vegetables studied can be considered as good source of carbohydrates they contain less than cereals. Regarding the energy values , no significant difference was observed in the 5% threshold for these varieties of okra.

Table 3. *Proximate chemical composition of the Baoule variety dried in sunlight*

	Zatta	**Abouakouassikro**	**Sinzibo**	**AVERAGE**	**DEVIATION**
Proteins %	17.15	17.14	17.16	17.15	0.01
Lipids %	2.14	1.73	2.20	2.02	0.25
Total sugars %	12	12	20	14.66	4,13
Reducing sugar en %	0.80	0.90	0.90	0.86	0,05
Vitamins E %	0.087	0.087	0.087	0.087	0
Moisture %	7.85	6.90	7.10	7.28	0.50
Ash %	9.80	9.85	9.20	9.61	0.36
Dry matter %	92.14	93.10	92.90	92.71	0.50
Total carbohydrates en %	63.06	64.38	64.34	63.92	0.75
Starch %	45.95	47.14	39.90	44.33	3.88
Sucrose %	10.64	10.54	18.14	13.10	4.35
Crude fiber %	7.58	7.96	7.96	7.83	0.21
Energy value in en kcal	340.10	341.65	345.80	342.51	2.94

Table 4. *Proximate chemical composition of the Dioula variety dried in sunlight*

	Zatta	Abouakouassikro	Sinzibo	AVERAGE	DEVIATION
Proteins %	15.75	15.77	15.73	15.75	0.02
Lipids %	2.12	2.10	2.30	2.17	0.11
Total sugars %	20	20	20	20	0
Reducing sugars %	0.80	0.80	0.90	0.83	0.05
Vitamins E %	0.15	0.15	0.15	0.15	0
Moisture %	7.50	7.10	7.40	7.33	0.20
Ash %	9.60	9.50	9.40	9.50	0.10
Dry matter %	92.3	92.90	92.60	92.60	0.30
Total carbohydrates %	65.03	65.53	65.17	65.24	0.25
Starch %	40.52	40.97	40.65	40.71	0.23
Sucrose %	18.24	18.24	18.14	18.20	0.05
Crude fiber %	11.33	7.76	8.14	9.07	1.96
Energy value in kcal	342.20	344.10	343.13	343.14	0.97

Tables 5 and 6 show respectively the proximate compositions of okra Baoule and Dioula varieties dried in an oven at 60° C for 48 hours. Lipid content, total sugars, reducing sugars, water, dry matter, sucrose are respectively from 1.70% to 2.20% , 8-12 % , 0.8 to 0.9 % , 2.50 to 2 , 51%, 97.48 to 97.50 % , 6.84 to 10.54 % for the Baoule variety against respectively 2.00 to 2.20 % , 4-8 % , 0.8 to 0.9 %, 2 40 to 2.60% , 97.40 to 97.60 % , 3.04 to 6.74 % for the Dioula variety. For these parameters, no significant difference was observed in the 5% threshold.

Protein, vitamin E, ash, total carbohydrate, starch, and crude fiber contents are respectively from 14.88 % and 14.89% , 0.085 %, 9.50 %, 70.81 to 71.22 %, 56.52 to 60.42 %, 5.23 to 5.88 % for the Dioula variety against respectively 17.08 to 17.12 %, 0.035 %, 9.20 to 9.30 %, 68.87 to 69.48 % 51.73 to 55 %, 6.57 to 6.80 % for the Baoule variety. For these parameters, a significant difference was observed in the 5% threshold. Regarding the energy values, no significant difference was observed in the 5% threshold for these varieties of okra. At 60 °C, the protein, fat, and ash of these two varieties of okra are similar to those proposed by Adetuyi et al. [21] and Agbo et al [22] for a fresh vegetable. The crude fiber content of two varieties of okra is somewhat lower than those proposed by Adetuyi et al [21].

Table 5. *Proximate chemical composition of the Baoule variety dried at 60°C in an oven*

	Zatta	Abouakouassikro	Sinzibo	AVERAGE	DEVIATION
Proteins %	17.08	17.10	17.12	17.10	0.02
Lipids %	2.10	1.70	2.20	2.00	0.26
Total sugars %	8	12	8	9.33	4.38
Reducing sugars%	0.8	0.9	0.9	0.86	0.05
Vitamins E %	0.035	0.035	0.035	0.035	0
Moisture %	2.50	2.52	2.51	2.51	0.01
Ash %	9.20	9.20	9.30	9.23	0.05
Dry matter %	97.5	97.48	97.49	97.49	0.01
Total carbohydrates %	69.12	69.48	68.87	69.15	0.30
Starch %	55	51.73	54.78	53.83	1.82
Sucrose %	6.84	10.54	6.74	8.04	2.16
Crude fiber %	6.70	6.57	6.80	6.69	0.11
Energy value in kcal	363.70	361.62	364.84	363.38	1.63

Table 6. *Proximate chemical composition of the Dioula varieties dried at 60°C in an oven (N = 3).*

	Zatta	Abouakouassikro	Sinzibo	AVERAGE	DEVIATION
Proteins %	14.88	14.87	14.89	14.88	0.06
Lipids %	2.00	2.10	2.20	2.10	0.10
Total sugars %	4	4	8	5.33	2.03
Reducing sugars %	0.80	0.80	0.90	0.83	0.05
Vitamins e %	0.085	0.085	0.085	0.085	0
Moisture %	2.40	2.50	2.60	2.50	0.10
Ash %	9.50	9.50	9.50	9.50	0
Dry matter %	97.60	97.50	97.40	97.50	0.10
Total carbohydrates %	71.22	71.03	70.81	71.02	0.20
Starch %	60.49	60.32	56.52	59.11	2.24
Sucrose %	3.04	3.04	6.74	4.27	2.13
Crude fiber %	5.23	5.88	5.88	5.66	0.37
Energy value in kcal	362.40	362.50	362.60	362.50	0.10

Comparison of proximate compositions of Baoule variety dried respectively in the sun and in an oven at 60°C (Tables 3 and 5) showed a significant difference at 5% for protein, crude fiber, dry matter, total carbohydrates, starch, moisture, vitamin E and the energy values. The energy values of the Baoule variety dried at 60 ° C remains higher than that dried in the sun (363.38% against an average of 342.51 %). No significant difference was observed at 5 % for the levels of lipids, total and reducing sugars, sucrose and ash from this variety of okra. Comparison of proximate compositions of Dioula variety dried respectively in the sun and in an oven at 60 ° C (Tables 4 and 6) showed no significant difference at 5% for the contents of lipids, ash, and reducing sugars. A significant difference was observed at 5 % for protein, total sugars, vitamin E, water, crude fiber, sucrose, dry matter, total carbohydrates, starch and energy values. The energy values of the Dioula variety dried at 60 ° C remains higher than that dried in the sun (362.50 against 343.14 Kcal).

4. Conclusion

Whatever the drying mode, these two varieties of okra are interesting energy values. In addition, this study allowed highlighting that the drying time and the final moisture content of the okra vary depending on the type of drying. When the drying is at 60 ° C, there is a loss of certain compounds such as catechic tanins, sterols, terpenes, leucoanthocyanes and Gallic tanins. Drying at 60° C would be more appropriate since it induces fewer changes in the proximate compositions of okra with higher energy values and a shorter time of drying.

References

[1] Hamon. S, Charrier. A. Large variation of okra collected in Benin and Togo. Plant Genetic Resources Newsletter (FAO / lBPGR) 56: 52-58, 1983.

[2] Hamon. S, Yapo. A. Disturbance induced within the genus Abelmoschus by the discovery of a second edible okra species in West Africa. Acta Hort. 182: 133-143, 1985.

[3] Hamon. S. Organization of its kind Abelmoschus (okra): Co-evolution of two species grown okra in West Africa (A.esculentus and A.caillei). Thesis Doctorate of Science. University of Paris -South, 216, 1987.

[4] Hamon. S, Chomchalow. N, Chantaraprasong. C, S. Chomchalow. S. Collecting germplasm Abelmoschus in Thailand. IBPGR / SEAN Newsletter (Bangkok), 11 (2): 2-6, 1987.

[5] Souci. W.S, Fachman. W, Kraut. H. Food composition and nutrition tables, 5th edition, revised and supplemented, 1994, p 915.

[6] Kouassi. J.B, Cisse-Camara. M, Sess. D. E, Tiahou.G. G., Ake. A. M, Djohan. F. Y. Determination of levels of iron, calcium, copper and zinc in two varieties of okra. Bulletin of the Royal Society of Sciences of Liege. 82: 22-32, 2013.

[7] Kouassi. J. B, Cisse-Camara. M,. Sess. D. E, Tiahou G. G, F. Y. Djohan. Determination of levels of Magnesium, Potassium, Manganese and Sodium two varieties of okra. Journal of Applied Biosciences. 67:5210-5218, 2013.

[8] Bagre. I, Bahi. C, Gnahoue. G, Djaman. A. J, Guede. G. F. phytochemical composition and in vitro assessment of the antifungal activity of extracts from the leaves of Morinda morindoides (baker) milne - redhead (rubiaceae) of Aspergillus fumigatus and Candida albicans. J. Sci. Pharm. Bio l 8 (1):15-23, 2007.

[9] Ribereau-gayon. J, Peynaud. E. Analysis and control of wine, 2nd ed. Lib.ch. Beranger, 46-78 and 289, 1958.

[10] BIPEA. International Bureau of Analytical Studies. Collection of methods of analysis of the European Communities. BIPEA, Gennevillier France, 51-52, 1976.

[11] Jedlicka. A, Klimes. J. Determination of water and fat-soluble Vitamins in different matrices using High-Performance Liquid Chromatography. Chem. Pap. 59 (3): 202 – 222, 2005.

[12] Dubois. M, Gilles. K, Hamilton. J, Rebers SMITN. P. Colorimetry method for determinations of sugars and related substances, Anal. Chem, 280: 350-356, 1956.

[13] FAO. Food and Agricultural Organization. Compositions foods calorie nutrients, FAO, Washington, 1947.

[14] Acourene, S, Tama. M. Physico-chemical characterization of the main cultivars of the region dates Ziban. Journal of Agricultural Research, 1 :59 -66, 1997.

[15] Linden. G. Technical analysis and control in the food industries. T2 Principles of analysis, Technical Documentation and techniques, 414-416, 1981.

[16] Bruneton. J. Pharmacognosy: Phytochemistry-plant medical cinales.2ème Technical editing and Documentation - Lavoisier, p. 915, 1993.

[17] Ho. C. T, Lee. C. Y, Huang. M. T. Phenolic compounds in food and their effects on health; antioxidants and cancer prevention. American Chemical Society. Washington DC, 1992.

[18] Rokia. S, Karadji. A. H, Dembele. O., Diallo. D. Diuretic and saluretic of a substance used in traditional medicine for the treatment of hypertension, Mali Medical, 4: 4, 2009.

[19] Pincemail. J. Meurise. M. R, Cleats. R, Defraigne. O. J. Evaluation Method antioxidant stress in humans. Importance for prevention. Cancerologie. Ed Med1 Sphere. 10, 1999.

[20] Kouassi. J. B, Cisse-Camara. M, Tiahou. G. G, Monde. A. A, Sess. D. E, Vama. E. T. Determination of physicochemical properties of two Varieties of okra traditionally dried. Journal of Food and Nutrition Sciences, 1- 4: 38-42, 2013.

[21] Adetuyi. P, Osagie. A.U, Adekunle. AT. Nutrients, anti-nutrients, minerals and zinc bioavailability of okra (Abelmoschus esculentus (L) Moench), J. Am Food. Nutr, 1 -2, p. 49-54, 2011.

[22] Agbo. A.E., Gnakri. D. M, Beugre. G. L, Fondio Kouame. C. Maturity of fruits okra four varieties and their nutrient composition. Electronic Journal of Food Chemistry and Plants, 3-1: 1-4, 2008.

[23] Oguntona.T. Green leafy vegetables in: Quality of plant food editors: Osagie AU and OU Eka editor; research unit after harvest, University of Benin, Benin City pp. 120-130, 1998.