ISSN 2664-4169 (Print) & ISSN 2664-7923 (Online)
South Asian Research Journal of Biology and Applied Biosciences
Abbreviated Key Title: South Asian Res J Bio Appl Biosci

| Volume-4 | Issue-4 | Sept-Oct -2022 | **DOI: 10.36346/sarjbab.2022.v04i04.004**

Original Research Article

Physico-Chemical and Sensory Evaluation of *Attoupkou* from Cassava Varieties with Colored Flesh

N'Goran Haddad Evelyne Patricia Abo[1], Adiko Cho Evelyne[1], Yapi Yapi Eric[1], Deffan Khando Prudence[1], Bouatene Djakalia[2*], Ebah Djédji Bomoh Cathérine[1]

[1]National Center for Agricultural Research (CNRA), 01 BP 1740 Abidjan 01, Côte d'Ivoire
[2]Department of Food Science and Technology, University Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire

***Corresponding Author:** Bouatene Djakalia
Department of Food Science and Technology, University Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire

Article History
Received: 25.08.2022
Accepted: 03.10.2022
Published: 15.10.2022

Abstract: Innovations on new cassava varieties are experiencing limited dissemination and sometimes remain unknown to development and producers. The present study is part of the popularization of these new varieties of cassava for the production of *Attoukpou*, a local dish. This study was conducted to evaluate the importance of certain improved cassava varieties in the production of *attoukpou*, a local food. To carry out this study, It was determined some physico-chemical and sensory parameters of *Attoukpous* from different varieties of cassava. Four varieties of cassava were used. It is about three improved varieties which are namely Bocou 2, 15(239)29, 15(127)21 and the traditional variety which is Bonoua. The results show differences on some physico-chemical components and sensory characteritics of *Attoupkous*. The pH vary from 3.89 to 4.76. Reducing sugar content varies from 0.24 to 0.66. Acidity vary from 0.13 to 0.34. The sensory test shows that this *attoupkous* produced were appreciated with overall scores ranging from 5 to 5.39. Regarding the level of appreciation, this *Attoupkous* had a very pronounced smell of fresh *attiéké* (7.65 to 6.50) and more fibers resulting in scores ranging from 6.76 to 7.018. As for the fermented aroma parameter, it was less pronounced. The *Attoupkou* produced from varieties with colored flesh are as well appreciated by consumers as those of the local variety (Bonoua).

Keywords: *Attiéké*, A*ttoukpou*, Cassava, Sensory analysis, Physico-chemical.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz), a starch-rich root crop native to South America (Celis, 1982), has become an important crop in the tropics. It is cultivated its leaves and especially for its tubers, which are very rich in starch (Kouakou *et al*., 2015). With an annual production of more than 268 million tons of fresh roots harvested in 2014, cassava accounts for 32% of the world's production of food roots and tubers after potato (Vernier *et al*., 2018). Expressed in dry matter, the production of roots and tubers is 295 million tons, with an average dry matter content of 35%, and that of cereals is 2.52 billion tons, with a dry matter content of 90% (Vernier P *et al.*, 2018). Cassava represents the third food product in the tropics after rice and maize and, constitutes the staple food of more than 500 million people (FAO, 2008). Cassava varieties are divided into two groups including sweet and bitter varieties (Diallo *et al*., 2013). The sweet varieties are used artisanally for human consumption, while the bitter ones are only used after industrial processing (Diallo *et al*., 2013). In West Africa, cassava root is used primarily in human food in various artisanal and industrial forms (Perrin, 2015). Cooked in various ways, cassava is used in a wide variety of dishes. The root has a delicate and distinctive flavor, and when boiled, can replace potatoes in many meals consisting of meat or fish (Yeboue *et al*., 2007). In Côte d'Ivoire, cassava has been processed into *attiéké* (cassava semolina), *attoukpou* (fermented cassava cake), *foutou* (cassava bread) and *Placali* (fermented and cooked cassava paste) (Koffi-Nevry *et al*., 2007). However, the average yield of this crop remains very low, around 7 tons per hectare, compared to the average yield of the neighboring Ghana, which reached 15 tons per hectare in 2010 (N'Zué *et al*., 2014). Yet research has developed improved cassava varieties with

high potential, as well as a technique for rapid propagation of cuttings by recropping to disseminate these varieties (N'Zué *et al*., 2014). Indeed, innovations on new cassava varieties experience limited dissemination and sometimes remain unknown to development services and producers.

With a view to popularizing these new cassava varieties, this study proposes to evaluate the importance of certain improved cassava varieties in the production of *attoukpou*, a local food.

It is specially to determine some physico-chemical and sensory parameters of *Attoukpous* from Bonoua and produced with varieties of cassava to colored flesh.

MATERIAL

The material used in this study is cassava (*Manihot esculenta*). Four varieties of cassava were used for the production of *attoukpou*, a local dish. It is about three improved varieties which are namely Bocou 2, 15(239)29, 15(127)21 and the traditional variety which is Bonoua. The improved varieties of Cassava have colored flesh (Figure 1). As to the traditional variety (Bonoua), the flesh is not colored. The flesh is white (Figure 2). The roots of cassava were 10 to 13 months old. These tubers come from the experimental plantations of the National Agricultural Research Center (CNRA) of Bouaké (Côte d'Ivoire).

Figure 1: variety of Manioc with colored flesh

Figure 2: white-fleshed cassava variety

Preparation of the Magnan

The preparation of the ferment can be done in two ways: the tubers are peeled, pre-cooked and left to ferment for 3 days in rice bags or they can be braised with the husk and left to ferment for about 7 days (Figure 3).

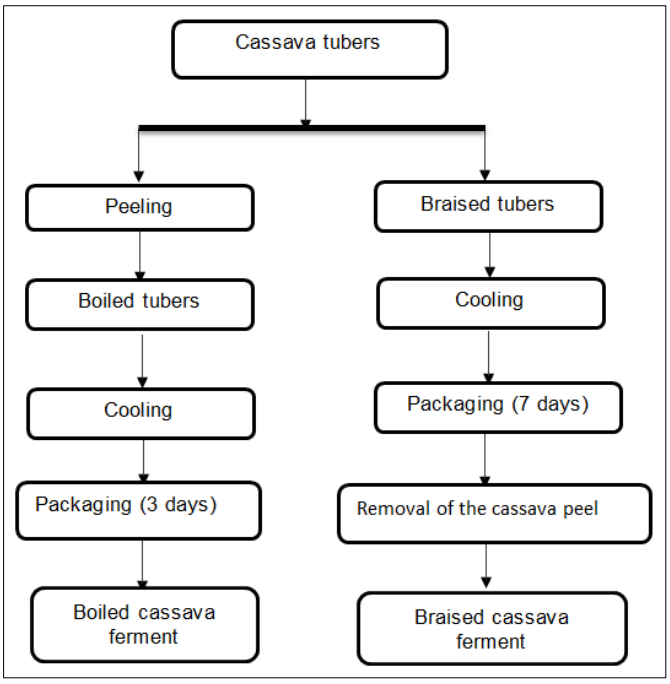

Figure 3: Diagram of the preparation of ferments

Preparation of Attoupkou

To prepare *attoukpou* in the Bonoua locality, cassava tubers with colored flesh were used compared to a white-fleshed cassava variety as a control. The tubers were peeled and washed and then a traditional ferment (magnan) produced from boiled or braised cassava tubers were added. The whole is crushed and packed in bags for fermentation. After these initial steps, the pressing and salting stages follow. During the preparation of the *attoukpou*, the dewatered paste is sieved and then granulated. The next step is the steaming of the semolina and the obtaining of cassava patties. These are packaged and preserved (Figure 4, 5 and 6).

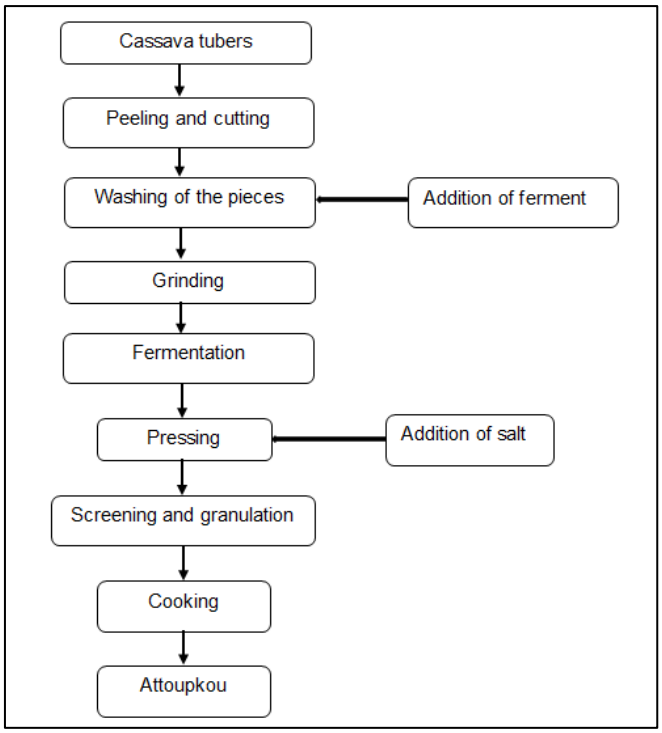

Figure 4: Production diagram of the attoukpou

Figure 5: *Attoupkou* (Bonoua variety)

Figure 6: *Attoupkou* (variety with colored flesh)

Physico-Chemical Analysis

Determination of Dry Matter Content

Dry matter content was determined according to the method of AOAC (1990). The samples of cassava tuber cossettes and *attoukpou* are weighed (Mo) with a scale (KERN EMB). They were put in an oven (type: UN55; 230 V-50/60) at 105°C for 24 h. At the exit of the oven, the samples were cooled in a desiccator (PYREX, FRANCE) and weighed. The dry matter content was determined from the following mathematical relations:

$$\text{Dry matter content (\%)} = \frac{(\text{M2} - \text{Mo})}{(\text{M 1} - \text{Mo})} X\ 100$$

Determination of Ash Content

Ash content was determined according to the method of AOAC (2005). This determination was made by mineralization of 5 g of sample (M0) incinerated for 5 h in a muffle furnace (VOLCA V50) at 550 °C, until destruction of all organic matter contained in the sample. Weighing (M1) after cooling in a desiccator of the obtained ash allowed to determine the ash rate according to the following mathematical formula:

$$\text{Ash (\%)} = \frac{(\text{M0} - \text{M1})}{\text{M0}} X\ 100$$

Determination of pH

The pH was determined with a pH meter by immersing the glass electrode of the pH meter. Pre-calibrated in 10 mL of supernatant obtained after maceration of 10 g of sample (cossettes and attoukpou) diluted in 75 mL of lukewarm distilled water (45°C). The mixture obtained is centrifuged. The pH of the sample is obtained by immersing the electrode

of the brand pH-meter (Eutech, Ion 510) previously calibrated in the supernatant collected after centrifugation. The pH value is read directly on the display of the pH meter.

Determination of Titratable Acidity

Titratable acidity was determined according to the AOAC (2000) method. The filtrate collected for pH determination was also used for titratable acidity determination. 10mL of each filtrate was taken and a few drops of phenolphthalein were added. The determination is done with 0.1N sodium hydroxide (NaOH).

Determination of Hydrocyanic Acid Content

Hydrocyanic acid content was evaluated by the method of Sylvestre and Arreaudau (1983). A mass of 20 g of the different samples was introduced in a flask and macerated in 200 ml of distilled water during 18 h. The whole (sample + distilled water) was homogenized and then distilled. The distillate containing HCN is collected in an Erlenmeyer flask containing 20 ml of 5% NaOH by completing this volume to 100 ml. 8 mL of 5% KI is added to the 100 mL NaOH-HCN mixture. To determine the hydrocyanic acid, a 0.02N $AgNO_3$ solution is used as the titrant solution. The determination of the mixture with the $AgNO_3$ solution is continued until the color changes to champagne. The hydrocyanic acid content is determined by the following formula:

$$\%\ HCN = \frac{V\ AgNO_3 \times 1.08 \times 100}{P}$$

V $AgNO_3$: Volume of $AgNO_3$ (ml)
P: Sample mass (g)

Determination of Reducing Sugar Content

The method of Bernfeld (1955) using DNS (dinitro-3,5- salicylic acid) was used to determine the amount of reducing sugars. A quantity of 0.1 ml of the water-soluble extract of the sugars was added to a test tube and then 0.1 ml of distilled water was added with a propette. 0.2 ml of DNS was added and the whole was placed for 5 min in a boiling water bath. The set is left to cool on the bench for 10 min. Then 3.6 ml of distilled water is added and the mixture is homogenized by vortex. The optical density (O.D.) is read against a blank at 546 nm with a spectrophotometer.

Sensory Evaluation

The evaluation of the sensory characteristics was made by 55 tasters-consumers of these dishes. The sensory parameters retained for the analysis of the *attoukpou* are the intensity of the color, the presence of fibers, the fermented aroma, the consistency, the sweet taste, the salty taste and the global appreciation. The questionnaires consisted of a hedonic scoring table (for the hedonic test) and a rating scale (for the performance test) where the panelist had to identify the nature of the differences and quantify them. The *attoukpou* samples were presented to panelists in a randomized order as advocated by Yéboué *et al*., (2017) for evaluation. Assessment scores ranged from 1 to 10 with 1 being "very poor," 5 being "acceptable," and 10 being "very good" allowing for comparison of *attoukpou* from the four colored-fleshed cassava varieties to the white-fleshed one (Bonoua).

Statistical Analysis

Responses were collected on the variables color, presence of fiber, aroma, sweet and salty, consistency and smell. A quantitative variable was then integrated: overall appreciation (Global App), corresponding to the average of the 8 variables and expressing the general appreciation of the product by each panelist. Principal Component Analysis (PCA), correlation analysis, variance analysis (KRUSKAL-WALLIS and ANOVA) and mean comparison tests (DUNCAN and KRUSKAL-WALLIS) were used. These analyses were performed using R i386 3.6.1, Statistica 7.1, and Excel 2016 software at the 5% threshold.

RESULTS

Physico-Chemical Properties

The Bonoua variety recorded the highest titratable acidity (0.34±0.04) compared to the improved variety 15 (239) 29 which recorded the lowest (0.13±0.05). There was no significant difference between the ash content, hydrocyanic acid content and reducing sugar content of the 4 varieties. As for dry matter (DM), a significant difference was recorded among the 4 varieties at the 5% threshold. Indeed, the control variety recorded the highest DM (55.99±1.18) compared to the improved variety Bocou 2 which recorded the lowest DM (49.21±0.13). At the level of pH, a significant difference between the 4 varieties was observed. The Bonoua variety had a pH (4.76±0.05) less acidic than

the improved varieties (15(127)21 and Bocou 2), which recorded the lowest values, in the order of (3.89±0.01) but they are more acidic At the level of the reducing sugar content, the rates were significantly different (Table 1).

Table 1: Physico-chemical characteristics of *attoupkou* from 4 varieties of cassava

Cassava variety	Acidity titrable	Ash	hydrocyanic acid	Dry matter	pH	reducing sugar
Temoin (Bonoua)	0,34±0,04 c	0,45±0,1 a	0,75±0,05 a	55,99±1,18 c	4,76±0,05b	0,36±0,05 a
15(127)21	0,2±0,01 ab	0,45±0,06 a	0,72±0,31 a	50,94±0,31 b	3,89±0,01 a	0,24±0,37 a
Bocou 2	0,26±0,05bc	0,49±0,08 a	0,90±0,31 a	49,21±0,13 a	3,90±0,01 a	0,63±0,51 b
15(239)29	0,13±0,05 a	0,54±0,1 a	0,72±0,31 a	50,43±0,23 ab	4,65±0,01b	0,33±0,01 a

a, b, c Values on the same line followed by different letters are significantly different at the 5% level

Sensory Profile of *Attoupkou*

The results of the acceptability test of the different *attoupkpou*, carried out by 55 regular tasters are recorded in the Table 2. These results showed that *attoupkou* from the Bonoua, Bocou2, 15 (239) 29 varieties were statistically identical. Moreover, the *attoupkou* produced were the most appreciated with overall scores of 5; 5.26 and 5.39 respectively. As for variety 15 (127) 21, it was the least appreciated with an overall rating of 4.46. *Attoupkpou* from coloured cassava varieties were more appreciated in terms of color (5.58 to 3.69) than those from the control variety (1.92). *Attoupkous* from the colored varieties had a pronounced odor of fresh attiéké (7.65 to 6.50), but presented more fiber resulting in scores above the average ranging from (6.76 to 7.018). The fermented aroma parameter was less pronounced (2.09 to 3.018). Regarding the consistency attribute, *attoupkou* produced were all consistent with scores ranging from 3.09 to 6.47. All *attoupkou* produced had a sweet taste (6.54 to 7.96) well perceived by the tasters and low saltiness resulting in scores ranging from (2 to 2.92).

Table 2: Level of appreciation of the different *attoukpous*

Parameter	15(127)21	Témoin (Bonoua)	Bocou 2	15(239)29
Colour	3.69±1.5 b	1.92±1.08 a	4.90±1.20 c	5.58±1.19 d
Odor	6.50±2.25 a	7.65±2.16 b	7.09±2.07 ab	7.25±2.31 ab
Presence of fiber	7.018±2.1 a	6.76±2.24 a	6.81±2.12 a	6.94±2.16 a
Fermented aroma mented)	2.38±1.5 ab	2.09±1.37 a	2.52±1.59 ab	3.018±2.22 b
Consistency	3.09±2.17 a	6.47±3.19 b	5.072±2.96 b	5.16±3.14 b
Sweet taste	6.54±2.60 a	7.96±2.26 b	7.54±2.36 ab	7.21±2.76 ab
Salty taste	2±1.41 a	2.18±1.37 ab	2.92±1.8 b	2.6±1.53 ab
Overall assessment	4.46±0.70 a	5±0.72 b	5.26±0.7 b	5.39±0.96 b

a, b, c Values on the same line followed by different letters are significantly different at the 5% level

DISCUSSION

Four varieties of cassava (Bonoua, Bocou 2, 15(127)21 and 15(239)29) were used to make *attoupkou*. The hydrocyanic acid content of the *attoupkou* produced from these varieties is very low, even in trace amounts. These low values could be due to the different stages of the cassava processing (washing, grinding, pressing and cooking) which would have reduced their content. Indeed, the work of (Gogbeu *et al*., 2011; Yeboue *et al*., 2017), would have shown that the steps of pressing, grinding and rapid drying of the pressed paste at more than 40 °C would favor the evaporation of residual hydrocyanic acid (HCN) contained in the cassava paste. These observations would also be consistent with those of Obilie *et al.*, (2003) and Onwaka and Ogboga (2007), who found that cassava fermentation, would promote the removal of HCN in fufu, dough prepared with fermented cassava flour. Nevry *et al*., (2007), found that the level of HCN in attoupkou would likely be lower if the fermentation, drying and cooking steps were longer. *Attoupkou* produced from the colored cassava varieties recorded a higher ph than the control. According to Nevry *et al.*, (2007), the acidity of *attoukpou* is explained by the fact that these dishes are prepared from the fermented cassava paste, which makes their pH more acidic than the tuber. This high acidity would also be due to the microbial activities that take place during the fermentation of the paste. Indeed, lactic acid bacteria and yeasts during the fermentation of the dough would produce organic acids whose accumulation would favor an increase in the acidity of the medium (Oduah *et al*., 2015; Kakou *et al*., 2017). In addition, this fermentation would have a double role; it would stabilize the finished products by lowering their pH and giving them the organoleptic characteristics (strong odor and acidic flavor) sought by consumers (Vernier *et al.*, 2018). The high dry matter content recorded in attoupkous from colored flesh varieties would indicate that the latter have a high energy value (Yéboué *et al.*, 2017; Nevry *et al*., 2007). In addition to the dry matter, the moisture content obtained (50%) is higher than that of *attiéké* (35%), which would indicate that *attoukpou* would be a favorable environment for the development of microorganisms, in particular molds, yeasts and bacteria (Nevry *et al*., 2006). High humidity will promote the development of microbial flora thus the perishability of attoupkou if precautions are not taken for its proper preservation (Yao *et al*., 2015b).

Tasting tests show an identical appreciation of attoukpou from varieties with colored flesh and white flesh. Indeed, the prepared *attoupkou* was sweet. One possible explanation could be a partial hydrolysis of the starch during cooking, which would release the glucose. These results obtained would corroborate with those of the work of Yeboue *et al*., 2017, on *placali* and those on cassava pellet-based dishes that would have observed a sweet taste on these different dishes (Padomou *et al*., 2005); Yao *et al*., 2015a).

The result of the appreciation tests confirms this observation, as the prepared *attoupkou*, were found to have better taste, smell, beautiful color with significant differences for the parameters. The four varieties have almost the same color with a dominance for the colored flesh varieties (dark yellowish), the same texture (consistent), same fiber presence. The four products have a slightly acidic taste; the flavor is light and the grains are homogenized. The creamy yellow color like that of traditional *attiéké* and *attoupkou* was highly appreciated. In addition, it should be noted that the moisture content of *attoukpou* is higher than that of *attiéké* and this is because during preparation, the semolina intended for the making of *attoukpou* is not dried but is cooked, immediately, after pressing and crumbling; which made it possible to obtain the *attoukpou* disc in a single block (Yao *et al*., 2015b). The stickiness between the semolina is one of the main parameters that guide the consumer's choice during the consumption of the dish. Thus, the 4 dishes have organoleptic characteristics that allow them to be well appreciated by consumers.

CONCLUSION

This study highlighted the acceptability of *attoukpou* produced from some improved varieties of cassava with colored flesh. The *attoukpou* produced from the four varieties showed good dry matter content, low reducing sugar content, acid pH, relatively low titratable acidity and trace amounts of hydrocyanic acid. At the organoleptic level, the *attoupkous* from the new varieties were appreciated in the same way as the white-fleshed variety with a good color, an acceptable aroma and a pleasant flavor.

REFERENCES

- Abodjo, C. K., Zamblé, B. I., Abel, B., Ollo, K., Koussemon, M., & Nevry, R. K. (2017). Fermentation kinetics of three methods of producing cassava root ferments. *European Scientific Journal*, 1(33)
- AOAC (1990). Analytical Chemists Association Functional Method of Analysis (15th Edition) AOAC. Washington, DC, USA, 684p.
- AOAC (2000). Analytical Chemists Association Official Method of Analysis (17th Edition) AOAC Washington, DC, USA
- AOAC (2005). Official method of analysis. 15th Edition Washington D.C.
- Arraudeau, M., & Sylvestre, P. (1983). Hydrocyanic toxicity in cassava, Agricultural techniques and tropical production, XXV, G.P Maisonneuve and Larose. *Agency for Cultural and Technical Cooperation*, Paris, France pp 100-135.
- Bernfeld, D. (1955). Amylase c and W. Method in enzymology (Colowick S. P., & Kaplan N. O., Eds.), Academic Press, New York: pp. 149-154.
- Celis, F. (1982). Handbook of plant science of starchy root and tuber crops. Ibadan, Nigeria: IITA.
- Diallo, Y., Gueye, M. T., Sakho, M., Darboux, P. G., Kane, A., Barthelemy, J. P., & Lognay, G. (2013). Nutritional importance of cassava and perspectives for staple food in Senegal, *Literature review, BASE [Online]*, 17(2-4), 634-643.
- FAO. (2008). The impact of HIV/AIDS on the agricultural sector. Corporate Document Repository. Rome, FAO.
- FAO. (2010). Cassava Diseases in Central, Eastern and Southern Africa (CaCESA) - Strategic Program Framework 2010-2015, Rome, FAO, 63 p.
- FAO. (2013). Save and Grow: Cassava - A guide to sustainable production intensification. Rome, FAO, IFAD. Global Cassava Development Strategy and Implementation Plan, p140.
- Gogbeu, J. S., Dogbo, D. O., Gonnety, T. J., N'Zué, B., Zohouri, G. P., & Boka, A. (2011). Study of some characteristics of the soluble polyphenol oxidases of six cassava callus cultivars (Manihot esculenta Crantz). *Annual Journal Plant Sciences*, 9, 1169-1179.
- Kouakou, J., Samuel, N. N., & Catherine, P. (2015). Cassava production and processing, Pro-Agro collection. 40 p
- Nevry, K. R., Kousssémon, M., & Aboua, F. (2007). Chemical and organoleptic properties of "attoukpou" made from two varieties of cassava (*Manihot esculenta* Crantz), Bonoua and IAC. *Journal of Food Technology*, 5(4), 300-304.
- N'Zue, B., Okoma, K. A. M., Dibi, K. E. B., Zohouri, G. P., Essis, B. S., & Dansi, A. A. (2014). Morphological characterization of cassava (*Manihot esculenta Crantz*), identified in the center-west, south-west and west of Côte d'Ivoire. *Green Journal of Agricultural Science*, 4, 220-231.
- Obilie, E. M., Tanoh-Debrah, K., & Amoa-Awua. (2003). Microbial modification of the texture of grated cassava during fermentation in akyeke. *International Journal Food Microbiology*, 89, 275-280.

- Oduah, N. O., Adepoju, P. A., Longe, O., Elemo, G. N., & Oke, O. V. (2015). Effects of fermentation on the quality and composition of cassava mash (Gari). *International Journal of Food Nutrition and Safety*, 6(1), 30-41.
- Onwaka, G. I., & Ogbogu, N. J. (2007). Effect of fermentation on the quality and physicochemical properties of cassava based Fufu products made from two cassava varieties NR8212 and Nwangbisi. *Medwell Journal of Food Technology*, 5, 261-264.
- Padonou, W., Mestres, C., & Nago, C. M. (2005). The quality of boiled cassava: instrumental characterization and relationship with physic-chemical properties and sensorial properties. *Food Chemistry*, 89, 261-270.
- Perrin, A., Ricau, P., & Rabany, C. (2015). Study of the cassava sector in Côte d'Ivoire, RONGEAD. *Project "Promotion and commercialization of plantain and cassava in Ivory Coast.*
- PPAAO & FIRCA. (2013). Directory of processes and technologies for cassava conservation and processing: Abidjan, Côte d'Ivoire. 154p.
- Vernier, P., N'Zué, B., & Zakhia-Rozis, N. (2018). Cassava, between food culture and agro-industrial sector, Quæ editions, CTA, *Gembloux agronomic presses* 208p.
- Yao, A. K., Djary, M., Koffi Sika, H. B., Zaouli, B . I., & Niamké, S. L. (2015b). New technique for processing cassava (*Manihot esculenta* crantz) pulp into pellets that can be preserved over a long period. *European Scientific Journal*, 11(24).
- Yao, A. K., Djary, M., Koffi Sika, H. B., Zaouli, B. I., & Niamké, S. L. (2015a). "Biochemical and organoleptic properties of three traditional Ivorian dishes (*attiéké*, *placali*, *attoukpou*) based on native cassava pellets. *International Journal of Biological and Chemical Sciences*, 9(3), 1341-1353.
- Yao, K. A. (2015). Contribution to the reduction of post-harvest losses of plantain (Musa AAB) and cassava (*Manihot esculenta* Crantz) by technological approaches of conservation and processing. *PhD thesis, University Félix Houphöuet-Boigny (Abidjan, Ivory Coast*), 158p.
- Yao, K. J., Koffi, R. A., & Aboua, F. (2006). Composition of dehydrated *attiéké* powder. Tropical. *Sciences*, 46(4), 224-226.
- Yéboué, K. H., Amoikon, K. E., Kouamé, K. G., & Kati-Coulibaly, S. (2017). Nutritional value and organoleptic properties of *attiéké*, *attoukpou* and *placali*, three cassava-based dishes commonly consumed in Côte d'Ivoire. *Journal of Applied Biosciences*, 113, 11184-11191.