Specific qualities of pressed fermented cassava doughs used for attiéké production based on their geographical origin in Côte d’Ivoire

Kouadio Benal Kouassi a,b, Charlemagne Nindjin a,b, Kouakou Nestor Kouassi a,b, and N’GUÉSSAN Georges Amani a

aFood Biochemistry and Technologies Department, Université Nangui Abrogoua, Abidjan, Côte d’Ivoire; Centre Suisse de Recherches Scientifiques En Côte d’Ivoire, Food Security and Nutrition Research Group, Abidjan, Côte d’Ivoire

ABSTRACT
Pressed fermented cassava dough is an intermediary product in attiéké production process. Its quality strongly influences that of the resulting final attiéké. With the goal to assess the typicity of attiéké from different areas, the specificity of the pressed fermented cassava doughs used for their production should be known. Thus, by analyzing the physicochemical properties and fermenting flora of samples, this study proposed to evaluate the specificity of pressed fermented cassava doughs from the five major producing areas of attiéké. Results revealed that doughs from Abidjan and Dabou presented same characteristics. Similar observation was noted for doughs from Jacqueville and Grand-Lahou being in the same group. And doughs from Yamoussoukro were isolated into a group with low counts of fermenting germs, high ash content, high pH, and starter rate. However, doughs from Abidjan and Dabou had higher counts of lactic bacteria and yeasts. They also had higher dietary fiber, starch, and moisture contents. Doughs from Jacqueville and Grand-Lahou were characterized by higher counts of aerobic mesophile germs, Enterobacteriaceae, Molds, and Bacillus. Total sugar and reducing sugar contents were high. Within each group of pressed fermented cassava dough, the physicochemical properties and microbiological compositions followed the same trends. These different types of pressed fermented cassava dough could result in attiéké of distinct qualities.

Introduction
Attiéké is a semolina of cassava steamed from the fermented dough. It is the traditional meal of lagoon people in the southern part of Côte d’Ivoire. The production of attiéké results in an ancestral know-how of the ethnic groups Avikam, E brié, Adjoukrou, Allanadj and Ahizi located in the lagoon area of Côte d’Ivoire. Thus, the production and consumption of attiéké were first confined in the geographical area of these people. Many years ago, attiéké has become a national dish whose production, marketing and consumption are done in all regions of the country and beyond the Ivorian borders. However, the typology and quality of these attiéké always depend on their origins or ethnic group of production. Studies conducted by Kouassi, Nindjin reveal the existence of five types of attiéké produced in Côte d’Ivoire according to the local ancestral know-how of indigenous women of the production areas. These types of attiéké are Agbodjama, N’Tonié, Ahité, attiéké with heterogenous grains (mixture of coarse, medium and small grains) and Garba. The production of attiéké consists of a succession of various unit steps generating several intermediate products. The pressed fermented cassava dough is one of these intermediate products. This dough, increasingly, constitutes the raw
material of attiéké producers in the West African sub-region. The quality of the pressed fermented cassava dough strongly affects that of the final resulting attiéké. This dough is obtained after fermentation of the product of cassava pulp crushing and reduction of water content by pressing. Fermentation promotes softening of the dough under the action of microorganisms incorporated via the starter. Indeed, the enzymes released by the sown flora help to improve the toxicological and nutritional quality of cassava. Thus, linamarase (β-glucosidase) helps to degrade linamarin, a toxic compound in cassava. Then the α-amylase will degrade cassava starch into fermentable sugars and provide the fermentation substrate to the entire microflora. Softening is caused by pectin methylesterase, which attacks pectin, the main rigid skeleton of cassava cells. In addition, the fermentation promotes the development of characteristic properties such as aroma, texture, taste, safety, and nutritional value of final attiéké. Pressing, on the other hand, considerably reduces the water content of the dough. This unit step is performed with the goal to reach the optimum residual water content of the dough to facilitate the next unit step and also obtain an intermediate product of quality. In sum, fermentation and pressing highlight the importance of the pressed fermented cassava dough which requires specific attention in the study of attiéké quality. Unfortunately, few studies focused energy on it. The more studied products are starter and attiéké. The work conducted by Akely, Nindjin showed the link between the residual water content of pressed fermented cassava dough and the size of the grains obtained after semoling. However, no data exists on the quality of pressed fermented cassava dough linked to the origin of production. The purpose of this study was to assess the specificity of pressed fermented cassava dough used in attiéké production in Côte d’Ivoire according to geographical origin.

**Methods**

**Study sites**

Five zones constituted the study sites: Grand-Lahou, Dabou, Jacqueville, and Abidjan which are the traditional and cultural Lagoon area of attiéké production and Yamoussoukro where production and sale of great quantities of attiéké are observed. In each locality, two villages were randomly chosen after an exploratory survey, based on the distance from the main town (≤ 45 km) and the presence of attiéké producers’ groups.

**Choice of sample suppliers and sampling**

The choice of sample suppliers, sampling methodology, and transport of samples are the same as described in previous studies. Indeed, this work is another step of that cited. After producing starters, the selected attiéké producers provided pressed fermented cassava dough following their own local know-how usually practiced. Samples were then collected and placed into a thermal container with dry ice and transported to the laboratory for subsequent analysis.

**Physicochemical analysis**

The rate of starter introduced into the dough for fermentation was determined for each of the women included in the study. First, the entire amount of unpeeled fresh cassava roots acquired by the producer for attiéké production was weighed. And then, the amount of starter used for its fermentation was weighed too. The rate of starter incorporated was then calculated according to Equation 1:

$$\text{Rate} = \frac{W_s}{W_r} \times 100$$  

(1)

With $W_s$: weight of starter and $W_r$, weight of fresh roots. Dry matter and moisture contents, titratable acidity and pH, starch content, residual sugar, reducing sugars, crude fibers, and cyanide content of samples were determined.
Microbiological analysis

Microbiological analysis consisted in counting fermenting germs involved in the fermentation of cassava dough. According to Nimaga, Tetchi (8),[9] and,[27] the microorganisms responsible for fermentation are mesophilic aerobic germs, lactic acid bacteria, yeasts, Enterobacteriaceae, molds and Bacillus spp. The preparation of analytical units, stock solution and decimal dilutions were done as described by Djéni, N’guessan (18). Enumeration of mesophilic aerobic germs (MAG) and lactic acid bacteria (LAB) were performed according to AFNOR Standard[28] using Plate Count Agar for MAG and Man Rogosa Sharpe agar for LAB. Enterobacteriaceae were counted on violet crystal and neutral red bile glucose agar according to NF ISO 03 453, 1995. Yeasts and Mold enumeration was carried out according to the Standard NF .[29] Bacillus counts were performed on Mossel Selective Agar. The Petri dishes containing between 15 and 300 colonies were counted in cfu g⁻¹.

Statistical analysis

One-Factor Analysis of variance was used to compare the physicochemical and microbiological parameters of samples with the analysis software STATISTICA 7.1. The equality of variance was verified first through the Levene test .[30,31] When a significant difference was observed between parameters, P ≤ .05,[32] multiple comparison was then performed using Duncan test. Principal component analysis (PCA) and Hierarchical agglomerative clustering (HAC) were carried out in addition with the analysis software XLSTAT 2014.5.03. PCA allowed grouping the different types of samples analyzed, according to their physicochemical properties and microbiological compositions. HAC agglomerated pressed fermented cassava dough samples based on the similarity of their physicochemical properties and microbiological compositions. The dendrograms were obtained applying a Ward algorithm for obtaining more distinct classes .[33]

Results

Starter rate

The rates of starter incorporated into cassava dough from the five production zones were presented in Figure 1. The highest starter rate was found in Yamoussoukro (11.86 ± 1.07%) and the lowest rate was that in Grand-Lahou (6.03 ± 0.20%). The starter rate in Abidjan was 9.62 ± 0.82%, this was statistically high than those in Dabou and Jacqueville which were 7.98 ± 0.57% and 7.84 ± 1.00%, respectively.

Physicochemical properties of pressed fermented cassava dough

Table 1 shows the physicochemical properties of the pressed fermented cassava doughs. No significant difference was observed between dry matter values of dough from Abidjan, Dabou, and Jacqueville (50.79 ± 0.66%; 51.00 ± 1.15% et 51.10 ± 0.99% respectively). However, these values differed significantly from those of doughs from Grand-Lahou (51.90 ± 1.03%) and Yamoussoukro (55.22 ± 0.44%). Regarding moisture contents, the pressed fermented cassava doughs had values varying from 44.77 ± 0.44% (dough from Yamoussoukro) to 49.21 ± 0.66% (dough from Abidjan). Indeed, doughs from Jacqueville, Dabou, and Abidjan production areas presented the highest values even though they were not statistically different. The dough from Grand-Lahou had an intermediate moisture content (48.40 ± 1.03%) and those from Yamoussoukro were drier with a lower moisture content (44.77 ± 0.44%). However, dough from Yamoossoukro had the highest ash content (0.70 ± 0.08%) comparatively to those from Dabou, Grand-Lahou, and Jacqueville areas, which had the lower ash contents (0.34 ± 0.08% to 0.39 ± 0.04%). Sample from Abidjan had an intermediate ash content (0.48 ± 0.05%). Furthermore, results showed that total acidity values of doughs from Yamoossoukro (11.07 ± 0.54 mg/L) and Abidjan (10.55 ± 2.64 mg/L) were high and statistically different to those from Dabou, Grand-Lahou and Jacqueville (7.13 ± 0.95 mg/L to 7.66 ± 1.36 mg/L). The pH of doughs varied from 4.16 ± 0.10 (Abidjan) to 4.60 ± 0.02
(Yamoussoukro). And doughs from Grands Ponts departments (Dabou, Grand-Lahou, and Jacqueville) had intermediate values ranging from 4.23 ± 0.06 (Jacqueville) to 4.33 ± 0.09 (Dabou).

Starch was the most predominant compound in doughs. High values were observed in all samples from Abidjan (11.77 ± 3.03 g/L) and Dabou (11.02 ± 2.57 g/L). The lowest value was found in cassava dough from Yamoussoukro (7.79 ± 1.64 g/L). Regarding total sugars, doughs from Dabou (3.16 ± 0.80 mg/100 g) and Grand-Lahou (3.62 ± 1.38 mg/100 g) had highest contents. Sample form Yamoussoukro had the lowest total sugar content (0.11 ± 0.00 mg/100 g). In contrast, the dough from Dabou had the lowest reducing sugar content with a value of 0.04 ± 0.03 mg/100 g, sample from Grand-Lahou having the highest value (0.29 ± 0.27 mg/100 g). The cyanide (HCN) contents of the pressed fermented cassava doughs were also determined. Doughs from Grand-Lahou showed highest value (17.08 ± 2.50 mg/L) and those from Abidjan the lowest value of 7.63 ± 2.99 mg/L. Finally, results show that dough from Yamoussoukro presented lower total fiber content (0.93 ± 0.53%) and those of the other areas had higher contents, form 1.52 ± 0.57% (Jacqueville) to 1.77 ± 0.75% (Dabou).

Fermenting germs of pressed fermented cassava dough of production zone

Table 2 describes the status of the fermenting germs of the pressed fermented cassava doughs. Indeed, the results showed that lactic bacteria, mesophilic aerobic germs, and yeast counts were slightly identical (p > .05) for doughs from Dabou, Jacqueville, and Grand-Lahou departments. Enterobacteriaceae, mold, and Bacillus counts were rather identical for doughs from Grand-Lahou and Jacqueville. These counts were significantly higher than doughs from Dabou, Abidjan, and Yamoussoukro for which no significant difference was observed.

Grouping of pressed fermented cassava doughs of the production zones according to their physicochemical properties and microbiological compositions

The Hierarchical agglomerative clustering (HAC) (Figure 3) and Principal component analysis (PCA) (Figure 2) showed three groups of pressed fermented cassava doughs according to their physicochemical properties and microbiological parameters. The first group (G 1) gathered doughs from Abidjan and Dabou. This group was characterized by high counts of lactic acid bacteria and yeasts, and low counts of aerobic mesophile germs, Enterobacteriaceae, mold, and Bacillus. This group was also characterized by high dietary fiber, starch, and moisture contents. Reducing sugars, total sugars, starter rate, titratable acidity, and ash contents were average, and the pH, HCN content were low.
| Location       | Dry matter (%) | Moisture content (%) | Ash (%) | Total acidity (mg/L) | pH | Starch (g/L) | Total sugar (mg/100 g) | Reducing sugar (mg/100 g) | Cyanide acid (mg/L) | Fibers (%) |
|---------------|----------------|----------------------|---------|----------------------|----|--------------|-------------------------|--------------------------|---------------------|------------|
| Abidjan       | 50.79 ± 0.66c  | 49.21 ± 0.66c       | 0.48 ± 0.05b | 10.55 ± 2.64a       | 4.16 ± 0.10d | 11.77 ± 3.03b | 2.40 ± 1.40bc            | 0.12 ± 0.11bc            | 7.63 ± 2.99c | 1.70 ± 0.80a |
| Dabou         | 51.00 ± 1.15c  | 49.00 ± 1.15c       | 0.34 ± 0.08c  | 7.66 ± 1.36b        | 4.33 ± 0.09b | 11.02 ± 2.57b | 3.16 ± 0.80c             | 0.04 ± 0.03c             | 9.81 ± 2.31c | 1.77 ± 0.75c |
| Jacqueville   | 51.10 ± 0.99c  | 48.90 ± 0.99g       | 0.39 ± 0.04a  | 7.13 ± 0.95b        | 4.23 ± 0.06c | 10.51 ± 2.74bc | 2.95 ± 1.12bc            | 0.19 ± 0.35bc            | 15.31 ± 2.52b | 1.52 ± 0.57c |
| Grand-Lahou   | 51.90 ± 1.03c  | 48.10 ± 1.03c       | 0.37 ± 0.06c  | 7.62 ± 0.84b        | 4.23 ± 0.09c | 12.80 ± 2.99f | 3.62 ± 1.38c             | 0.29 ± 0.27c             | 17.08 ± 2.50c | 1.52 ± 0.74c |
| Yamoussoukro  | 55.22 ± 0.44a  | 44.77 ± 0.44f       | 0.70 ± 0.08a  | 11.07 ± 0.54a       | 4.60 ± 0.02a | 7.79 ± 1.64c | 0.11 ± 0.00c             | 0.08 ± 0.02bc            | 16.58 ± 2.36b | 0.93 ± 0.53b |

The values of column with the same letters are not significantly different.
Table 2. Fermenting germs of pressed fermented cassava dough (log N + 1).

|                | LAB    | Aerobic mesophiles | Enterobacteriaceae | Yeasts | Molds | Bacillus |
|----------------|--------|--------------------|--------------------|--------|-------|----------|
| Grand-Lahou    | 6.84 ± 0.22<sup>b</sup> | 8.15 ± 0.54<sup>a</sup> | 3.38 ± 1.66<sup>a</sup> | 5.67 ± 0.93<sup>a</sup> | 3.92 ± 2.17<sup>a</sup> | 4.42 ± 0.52<sup>a</sup> |
| Jacqueville    | 6.91 ± 0.38<sup>b</sup> | 7.90 ± 0.41<sup>b</sup> | 3.87 ± 0.92<sup>b</sup> | 5.80 ± 0.53<sup>b</sup> | 3.84 ± 2.06<sup>b</sup> | 4.41 ± 0.52<sup>b</sup> |
| Dabou          | 6.83 ± 0.16<sup>b</sup> | 7.93 ± 0.45<sup>b</sup> | 0.94 ± 1.48<sup>b</sup> | 6.03 ± 0.37<sup>b</sup> | 2.10 ± 2.21<sup>b</sup> | 2.63 ± 2.07<sup>b</sup> |
| Abidjan        | 7.45 ± 0.32<sup>b</sup> | 6.69 ± 0.61<sup>b</sup> | 1.86 ± 0.98<sup>b</sup> | 5.91 ± 0.43<sup>b</sup> | 0.54 ± 1.26<sup>c</sup> | 2.08 ± 2.17<sup>b</sup> |
| Yamoussoukro   | 6.82 ± 0.99<sup>b</sup> | 5.44 ± 0.82<sup>b</sup> | 1.41 ± 0.23<sup>b</sup> | 4.67 ± 0.65<sup>b</sup> | 0.00<sup>a</sup> | 2.31 ± 1.85<sup>b</sup> |

The values of a column with the same letters are not significantly different; LAB: Lactic Acid Bacteria; N =cfu/g

Figure 2. Projection of pressed fermented dough, physicochemical, and microbiological compositions on the plan defined by the two first axes (1 and 2) of PCA. Abjan: Abidjan; Yakro: Yamoussoukro; Gd-L: Grand-Lahou; Jacqueville: TS: Total sugar; RS: Reducing sugar; %H: Moisture content; FC: Fiber content; AC: Ashes content; HCN: Cyanide content; S<sub>r</sub>: Starter rate; AMG: Aerobic mesophile germ; LAB: Lactic Acid Bacteria; Enterobacteriaceae.

The second group (G 2), with doughs from Jacqueville and Grand-Lahou had high counts of aerobic mesophile germs, Enterobacteriaceae, mold, yeasts, and Bacillus while those of lactic acid bacteria were average. The total sugars, reducing sugars, and HCN contents were high. Dietary fiber, moisture content, titratable acidity, starch, contents, and pH were average While starter and ash rates had low values. Finally, the third group (G 3), with the dough from Yamoussoukro only, was distinguished by

Figure 3. Clustering of pressed fermented dough of production zones according to their physicochemical properties and microbiological compositions. G: group; Yakro: Yamoussoukro; Abjan: Abidjan; Jville: Jacqueville; Gd-L: Grand-Lahou
its high ash content, high pH, and starter rate, then low values of moisture, fiber, starch, total sugars, HCN and reducing sugars contents. In addition, fermenting germ counts were low with an absence of molds.

**Discussion**

The cassava dough quality affects the final quality of the resulting attiééké. Especially since the dough is the seat of fermentation, which influences not only the following steps but also the quality of the final product. The pressed fermented cassava dough targeted in this study is that which has undergone fermentation and pressing and can go for the next step of attiééké production. The results showed that the residual water content of pressed fermented cassava dough from Yamoussoukro department was lower (44.77 ± 0.44%) than that of doughs from other areas (48.10 ± 1.03% to 49.21 ± 0.66%). This is explained by the fact that producers from Yamoussoukro department no longer perform any steps after sieving. They start cooking right away. However, to facilitate subsequent semoling, producers in the South kept the residual moisture content high. Nevertheless, this rate was low compared to the optimal content reported by Akely in 2013 which is 52%.[34] The residual microbial flora of pressed fermented cassava dough was dominated by mesophilic aerobic germs, lactic acid bacteria, and yeasts. *Enterobacteriaceae*, molds and *Bacillus* were also observed. The action of these germs consisted of softening the doughs, detoxifying them,[35] and improving their nutritional qualities.[17] Thus, the doughs counts would reflect the quality of the fermentation. The higher the fermenting germs counts, the dough is well fermented and the biochemical compounds (carbohydrate, starch, protein, fibers) contents are high.[17,27,36] Results showed that doughs from Yamoussoukro recorded the lowest microbial counts and the other groups of doughs had higher counts for most of the germs. Then, the physicochemical properties of doughs followed the same trend as the microbial counts. Indeed, the doughs with higher microbial counts also had high total sugars, reducing sugars, dietary fibers, starch, and dry matter contents. These results could be explained by the fact that the starters which were used for sowing dough had different initial counts.[20] In addition, fermentation was also differently practiced by producers. One of the important parameters during fermentation is the time[9] which is estimated at 12 hours.[8] The fermentation time of dough in Yamoussoukro varied from 30 minutes to 1 hour. This time was therefore insufficient to guarantee quality fermentation. In contrast, traditional producers in the South of the country (Abidjan, Dabou, Jacqueville, and Grand-Lahou) observed 12 hours of fermentation justifying the best quality of their doughs. However, a difference was noticed between groups 1 and 2. This could be explained by the age of the cassava roots used and the different environmental conditions of zones. Indeed, despite the identical fermentation time, the dough residual cyanide content remained high in Grand-Lahou (17.08 ± 2.50 mg/ L) and Jacqueville (15.31 ± 2.52 mg/ L). According to Diallo, Gueye (19) and,[37] the cyanogenic compounds content in cassava roots varies depending on the age of the variety and environmental conditions such as soil humidity and temperature.

**Conclusion**

The assessment of the specificity of pressed fermented cassava dough for attiééké production in Côte d’Ivoire linked to geographical origin showed three different groups or types of doughs. The microbial counts of these groups of doughs had the same trend than their physicochemical properties. Doughs from Yamoussoukro which had lower count of fermenting germs got lower content of carbohydrate. Moisture content was also low. Both remained groups were from lagoon zones. Even if their moisture contents were high, difference were observed in the nature and counts of the residual germs. Physicochemical compounds amounts were different too. These different types of pressed fermented cassava doughs could lead to attiééké with distinct qualities.
Acknowledgments

Authors extend their sincere thanks to the Programme d’Appui Stratégique à la Recherche Scientifique (PASRES N° 98) and to the Fonds Interprofessionnel pour la Recherche et le Conseil Agricole (CSRS/FIRCA_IG Contrat n° 003/CS/PPAAO/2013) for funding this work. Moreover, they thank the Centre Suisse de Recherches Scientifiques en Côte d’Ivoire (CSRS) for its technical assistance. Authors also express their gratitude to all attiéché producers of the study sites for having agreed to participate freely in the study, without forgetting all their peers for their wise advice. The authors would like to thank the Upssala University for funding this research through ISP/IPICS/RABIOTECH project at UJKZ.

Authors’ contributions

N’Guessan Georges AMANI, Charlemagne NINDJIN, and Kouadio Benal KOUASSI designed the study. Charlemagne NINDJIN and Kouadio Benal KOUASSI were co-principal investigators of the study. Charlemagne NINDJIN was responsible for the overall coordination of the study. Kouadio Benal KOUASSI oversaw sample collection, laboratory work, and data analysis. He also wrote the first draft of the paper. Kouakou Nestor KOUASSI, Charlemagne NINDJIN, and Kouadio Benal KOUASSI revised the paper. All authors read and approved the final version of the manuscript prior to submission.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Programme d’Appui Stratégique à la Recherche Scientifique [PASRES N° 98] and the Fonds Interprofessionnel pour la Recherche et le Conseil Agricole [CSRS/FIRCA_IG Contrat n° 003/CS/PPAAO/2013] research project grant; Fonds Interprofessionnel pour la Recherche et le Conseil Agricole [CSRS/FIRCA_IG Contrat n° 003/CS/PPAAO/2013] (FIRCA; Programme d’Appui Stratégique à la Recherche Scientifique (PASRES)).

ORCID

Kouadio Benal Kouassi [http://orcid.org/0000-0001-9396-3145

Data availability statement

The data that support the findings of this study are available from the authors upon reasonable request and with permission of the principal investigators.

References

[1] Ebah Djédji, C.; Diby, N. N. A. S.; Kanon, L.; Yapi, E.; Bechoff, A.; Adinsi, L., et al. Consumer Testing of Attiéché in Rural and Urban Areas in Côte d’Ivoire; Understanding the Drivers of Trait Preferences and the Development of multi-user RTB Product Profiles, WP1, Step 4. Bingerville, Côte d’Ivoire. RTB foods Field Scientific Report. 2022; 18.
[2] Kouassi, K. B.; Nindjin, C.; Kouassi, K. N.; Mobio, A. J.; Amanzou, N. A. A.; Dao, D., et al. Quality Standards and Typicity of Attiéché of the Lagoon People of Côte d’Ivoire. Eur. J. Sci. Res. 2016, 141, 82–92.
[3] Mobio, A. J.; Fokou, G.; Aka, S.; Kouassi, K. B.; Kreppel, K. S.; Kouakou, K. P.; Amanzou, N. A. A.; Dao, D.; Bonloho, B., et al. Exploring beyond the Conjunctural Rhetoric: Sociocultural Drivers for the “Cassava Crisis” in Côte d’Ivoire. Agric. Food Econ. 2021, 9(1), 1–20.
[4] Assanvo, J.; Agbo, G.; Behi, Y.; Coulin, P.; Farah, Z. Microflora of Traditional Starter Made from Cassava for “Attiéché” Production in Dabou (Côte d’Ivoire). Food Control. 2006, 17(1), 37–41. DOI: 10.1016/j.foodcont.2004.08.006.
[5] Bouatenin, K. M. J.-P.; Kouame, K. A.; Djení, N.; Koffi, N.; Dje, K. M. Production of Attie and by the Technique of Drying of Cassava Fermant. J. Food Qual. 2021, 2021, 7. DOI: 10.1155/2021/6697835.
[6] Bouatenin, K. M. J.-P.; Djení, N.; Kakou, A. C.; Menan, E. H.; Dje, K. M. Optimisation de La Production de L’[alpha]-Amylase Par Les Microorganismes Isolés Des Ferments Traditionnels de Manioc Provenant de Trois Zones de Production de L’attie à En Côte d’Ivoire. Eur. Sci. J. 2016, 12(9), 259–272.
Comptage NF Roots Bradbury, Bernfield, and Kouassi, manioc 2010.09.032 Sci. Microbiol. Cassava Brauman, Zakariyah, Kolapo, Bobolo Ze, and Akely, (Côte d’Ivoire). Food Microbial Djéni, 4236/fns.2012.310176 in Hagretou, Cassava Three Related Activities d’Ivoire. Food Microbial Djéni, 2021. A. A. A. et/ou Maisyi et W.; et/ou produis "Attiéké. J. Anim. Plant Sci. 2021, 54(1), 9821–9831. Dje, K.; Djé, et N’guesant, K.; Toka, D.; Kouamé, K.; Djé, K. Quality of Attieké (A Fermented Cassava Product) from the Three Main Processing Zones in Côte d’Ivoire. Food Res. Int. 2011, 44(1), 410–416. DOI: 10.1016/j.foodres.2010.09.032.

Diallo, Y.; Gueye, M. T.; Sakho, M.; Darboux, P. G.; Kane, A.; Barthelemy, J.-P., et al. Importance nutritionnelle du manioc et perspectives pour l’alimentation du base au Sénégal (synthèse bibliographique)/Nutritional importance of cassava and perspectives as a staple food in Senegal. A review. Biotechnologie Agronomie Société et Environnement. 2013, 17(4), 634.

Kouassi, K. B.; Kouassi, K. N.; Nindjin, C.; Amani, N. G. G. Physicochemical and Microbiological Characteristics of Cassava Starters Used for the Production of the Main Types of Attieké in Côte d’Ivoire. Int. J. Nutr. Sci. Food Technol. 2018, 4(8), 54–59.

Fontana, A. J.; Brady, P. C. Measurement of Water Activity, Moisture Sorption Isotherm, and Moisture Content of Foods. Water Activity in Foods: Fundamentals and Applications, 2nd Edn; John Wiley & Sons, Inc., 2020; pp 20.

Hassid, W.; Neufeld, E. F. Quantitative Determination of Starch in Plant Tissues. Methods Carbohydr Chem. 1964, 4, 33–36.

Dubois, M.; Gilles, K. A.; Hamilton, J. K.; Rebers, P.; Smith, F. Colorimetric Method for Determination of Sugars and Related Substances. Anal. Chem. 1956, 28(3), 350–356. DOI: 10.1021/ac60111a017.

Bernfeld, P. Amylases a and b. Methods in Enzymology I 9th edn, Colowich, S. P., Kaplan, N. O., Eds.; Academic Inc: New York, 1955, Vol. 1, 149–158

Wolff, J. P. Manuel d’analyse des corps gras; Azoulay éd: Paris (France), 1968; pp 519.

Bradbury, M. G.; Egan, S. V.; Bradbury, J. H. Picrate Paper Kits for Determination of Total Cyanogens in Cassava Roots and All Forms of Cyanogens in Cassava Products. J. Sci. Food Agric. 1999, 79(4), 593–601. DOI: 10.1002/SIC1.1097-0010(19990315)79:4<593::AID-JSF222>3.0.CO;2-2.

Muandze Nzambé, J. U.; Guiira, F.; Cissé, H.; Zongo, O.; Zongo, C.; Djibrine, A. O., et al. Technological, Biochemical and Microbiological Characterization of Fermented Cassava Dough Use to Produce Cassava Stick, a Gabonese Traditional Food. Int. J. Multidiscip. Curr. Res. July/Aug 2017, 5: 808–817

NF V08-051. Microbiologie des aliments Dénombrement des microorganismes par comptage des colonies obtenues à 30° celsius. Méthode de routine. Lavoisier ed 1999, 8.

ISO 6611. Lait et produits laitiers-Dénombrement des unités formant colonie de levures et/ou moisissures-Comptage des colonies à 25 degrés C 2004. p. 9
[30] Suffert, F. Modélisation de cinétiques de la maladie de la tache de la carotte provoquée par un complexe d’agents pathogènes du genre Pythium dominé par le Pythium violae. *Can. J. Plant Pathol.* 2007, 29(1), 41–55. DOI: 10.1080/07060660709507436.

[31] Tchuigoua, H. T. Etude Comparative Des Performances Des Institutions de Microfinance d’Afrique Sub-Saharienne Selon Leur Statut Légal. *Ann. Public Cooperat. Econ.* 2011, 82(1), 63–76. DOI: 10.1111/j.1467-8292.2010.00430.x.

[32] Vessereau, A. *Méthodes statistiques en biologie et en agronomie*; Diffusion TEC & DOC Lavoisier: Paris, 1992; pp 337.

[33] Bruynooghe, M. Classification ascendante hiérarchique des grands ensembles de données: Un algorithme rapide fondé sur la construction des voisinages réductibles. *Cahiers de l’Analyse des Données.* 1978, 3(1), 7–33.

[34] Akely, P. M. T. Influence de la fermentation contôlée, du pressage et de la granulation mécanisés du manioc (*Manihot esculenta Crantz*) râpé sur les caractéristiques physico-chimiques et sensorielles de “l’attiéké.” Thèse de Doctorat unique.: Université Nangui Abrogoua, Abidjan, Côte d’Ivoire; 2013.

[35] Amajor, J. Effect of Fermentation on the Chemical and Microbial Load of Cassava Mash. *Nigeria Agric. J.* 2022, 53(1), 291–296.

[36] Djouldé, D. R.; NGang Essia, J. J.; Etoa, F.-X. Amelioration Du Rouissage Du Manioc Par Utilisation D’un Starter Microbien de Trois Souches [Amelioration of Cassava Retting by a Stater Culture of Three Strains]. *Int. J. Innovation Sci. Res.* 2015, 14(2), 268–277.

[37] Gnamien, A. C. A.; Martial-Didier, A. K.; Martin, D. K.; Messou, T.; Honora, T.-B. F.; Kablan, T. Effect of Harvest Date on Technological Yield and Evolution of Hydrocyanic Acid Loss Rate after Transformation of Cassava Root (*Manihot Esculenta CRANTZ*) from Yacé Variety by Placali and Attiééré Consumed in Côte d’Ivoire. 2020.