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Research Article

Physicochemical, Nutritional and Sensory Characterization of Fresh and Dried Fermented Couscous Made from White-fleshed Sweet Potato and Cassava in Burkina Faso

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Abstract

White-fleshed sweet potato (*Ipomoea batatas* L.), grown in Burkina Faso, suffers from post-harvest losses despite its potential for food security and agri-food processing. The objective of this study was to characterize the physico-chemical and organoleptic properties of fresh and dried fermented couscous based on sweet potato and cassava developed. A total of six couscous formulations made from sweet potato and cassava were developed, comprising three dried formulations of the '*gari*' type, named GP100, GP75M25 and GP50M50, and three fresh formulations of the '*attieke'* type, named AP100, AP75M25 and AP50M50. The methodology involved determining the pH, acidity, particle size distribution, protein content, fat content and sensory characteristics using standardised methods. Carbohydrate content and energy value were calculated using a differential method and the Atwater coefficients, respectively. The results revealed that all samples had satisfactory physico-chemical, nutritional and organoleptic characteristics that were appreciated by the tasters. Also, the inclusion of sweet potato alters the nutritional profile of these products, with the energy value of *gari* ranging from 390.75 to 392.88 kcal and that of *attieke* from 395.73 to 396.45 kcal. A slight decrease in the scores for appearance and colour was observed for the 100 per cent potato formulations compared with those containing 75 per cent and 50 per cent. These new products would help to promote white-fleshed sweet potatoes.

Keywords

White-fleshed Sweet Potato, Fermented Couscous, Physico-chemical, Nutritional and Organoleptic

1. Introduction

Sweet potato (*Ipomoea batatas* L.) is a perennial dicotyledonous plant belonging to the Convolvulaceae family. It originates from the tropical regions of Latin America. Among approximately 50 genera and more than 1,000 species of Convolvulaceae, I. batatas is the only cultivated plant of major economic importance. Within the genus Ipomoea, sweet potato is the only species that produces large edible tubers [1]. These tubers may be elongated, round or oval in shape, with a smooth or rough surface and thin skin [1].

In Burkina Faso, sweet potato is a rapidly developing crop,

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dominated by white-fleshed varieties, which are the most widely consumed [2]. The main production areas are located in the Cascades, West, Centre-West, South, Centre-South, Centre-East and East regions of Burkina Faso [3]. They are found specifically in the provinces of Gourma, Kenedougou, Kouritenga, Nahouri and Sissili [4]. It ranks third in Burkina Faso, after cereals and legumes, among all crops grown [5]. It is of major nutritional interest for human food. Although it is among the most widely consumed tubers, products derived from its processing remain limited in diversity [6]. The nutritional composition of white-fleshed sweet potato shows that, in addition to carbohydrates (86%), it contains protein (13.7–15.2% DM (Dry Matter)) and minerals such as magnesium (41–65.7 mg/100 g DM), iron (25.7–44.7 mg/100 g DM), zinc (1.9–2.4 mg/100 g DM), copper, manganese, calcium (85.9–266.8 mg/100 g DM) and potassium (1596–2341 mg/100 g DM) [7, 8]. In addition, it contains particular functional properties such as bioactive carbohydrates, flavonoids, anthocyanins and phenolic acids in its leaves and roots [9].

Cassava is the staple food of about 800 million people in sub-Saharan Africa, Asia and Latin America [10, 11]. It is mainly a source of carbohydrates, accounting for approximately 80 to 90% of its dry-matter composition. Its carbohydrate content consists mainly of starch, at about 80%, together with smaller amounts of sucrose (36–46 mg/g), glucose (5–14 mg/g) and maltose (2–19 mg/g) on a dry-weight basis. The protein content of sweet potato is relatively high, ranging from about 1.7 to 9% of dry matter, and appears higher than that of cassava, whose protein content generally ranges between 1 and 5% of dry matter [12]. Cassava roots also contain vitamins A, C and E, as well as several minerals such as calcium (143–342 mg/100 g DM), magnesium (83.85–122.39 mg/100 g DM), sodium, potassium (1533.39–3065.35 mg/100 g DM), iron (7.7–60.6 mg/100 g DM), phosphorus and chloride [13, 14]. Cassava is a raw material widely valorised through the preparation of a variety of food products. It is notably processed into several traditional dishes, among which are *attieke*, placali, *gari*, attoukpou and tapioca [15].

Cassava-based products such as *gari*, tapioca and *attieke* are foods highly prized by the population of Burkina Faso, yet they are made from cassava. White-fleshed sweet potato is consumed boiled or fried.

Sweet potato and cassava are both tubers with similar technological characteristics. They are perishable commodities with a limited shelf life after harvest [16, 17]. Processing is an alternative and a means of obtaining products with a long shelf life, thereby reducing losses [18]. However, the production of white-fleshed sweet potato couscous of the *gari* type and *attieke* is absent in the literature. Yet these dishes can constitute a food base capable of meeting the growing needs in terms of food availability and demand, under the effect of the growth of the rural and urban population of Burkina Faso [19, 20].

Burkina Faso's current strategy is to explore and develop innovative processing methods to add value to local products.

With this in mind, the present study focuses on adding value to sweet potato produced in Burkina Faso through its partial or total use as a substitute for cassava in the production of fermented couscous.

The general objective of this study is to characterize the physico-chemical, nutritional and organoleptic properties of fresh and dried fermented couscous made from white-fleshed sweet potato.

2. Materials and Methods

2.1. Plant Material

The plant material consisted of white-fleshed sweet potato (Figure 1) and cassava (Figure 2) tubers purchased from a producer in the town of Leo, the administrative centre of Sissili Province in the Nando region of Burkina Faso. The refined palm oil used as an ingredient was purchased in a market in the town of Ouagadougou.



Figure 1. *White-fleshed sweet potato tuber.*



Figure 2. *Cassava tubers.*

2.2. Product Formulation

Three formulations were developed by varying the proportions of cassava and white-fleshed sweet potato, with the addition of Cassava ferment amounting to 10% of the total formulation weight. The various formulations used to produce fresh and dried fermented couscous are presented in Table 1.

Table 1. *Formulation of fresh and dried fermented couscous.*

Product	Formulation	WFSP rate (%)	Cassava rate (%)
Dried fermented couscous (*gari*)	GP50M50	50	50
	GP75M25	75	25
	GP100	100	0
Fresh fermented couscous (*attieke*)	AP50M50	50	50
	AP75M25	75	25
	AP100	100	0

WFSP: White-Fleshed Sweet Potato, G: *gari*, P: sweet potato, M: Cassava, A: *attieke*

2.3. Production Method

2.3.1. Pretreatment of the Raw Material

The cassava and sweet potato tubers were carefully washed to remove any impurities, then peeled and cut into slices.

2.3.2. Ferment Production

Fermentation of the cassava paste for the production of *attieke* and *gari* requires the use of a starter containing the lactic acid bacteria responsible for fermentation.

To produce this starter, cassava tubers were washed, peeled and cut into slices about 5 to 7 cm in size before being boiled for 10 to 15 minutes. The fermentation occurred naturally for 72 hours (3 days) at ambient temperatures of 25–30 ℃. The fermentation was carried out using microorganisms naturally present in the raw material. The diagram in Figure 3 presents the different steps in producing the starter, or "*magnan"* (Figure 4).

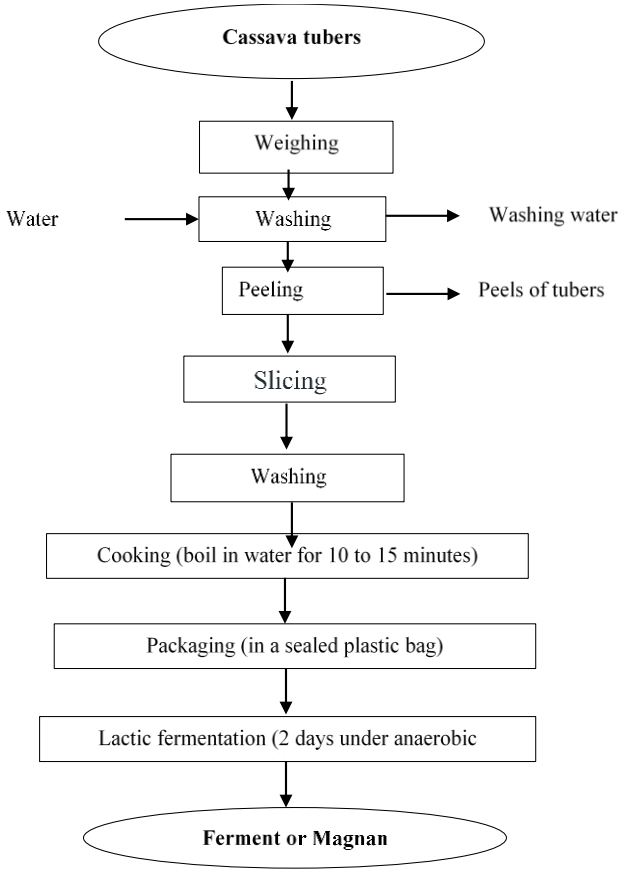


Figure 3. *Diagram of magnan (starter) production [20].*



Figure 4. *Cassava-based ferment.*

2.3.3. Tuber Paste Production

The tuber slices were mixed according to the different formulations and ground to obtain a homogeneous paste, following the formulations defined in Table 1 (different rates of cassava, WFSP and cassava ferment), and 2% palm oil was added to obtain the paste (Figure 5).



Figure 5. *Tuber paste.*

The percentage of cassava-based starter and the percentage of oil refer to the percentage of the formulation mixture.

2.3.4. Couscous Production

The diagram in Figure 6 presents the different steps in the production of tubers paste, *gari* and *attieke*.

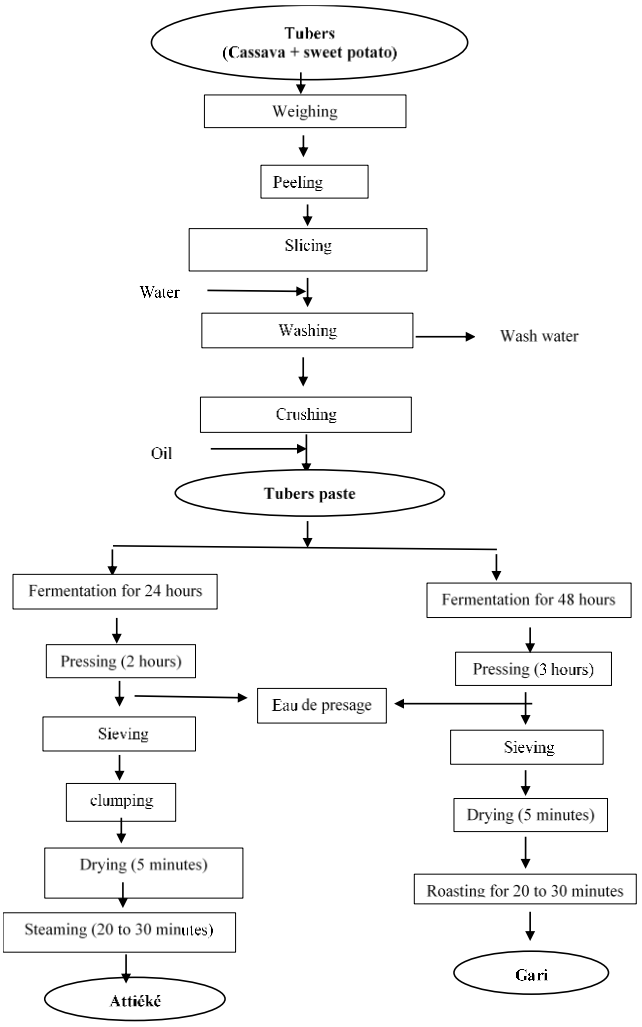


Figure 6. *Diagram showing the production of tubers paste, attieke and gari at PDCB (Diagram adapted from Lingani and al. [20].*

To produce dried couscous, type *gari*, after the pretreatment steps, the transformation of the cassava and white-fleshed sweet potato mixture into *gari* follows several successive steps. The mixture is first subjected to fermentation at room temperature for about 48 hours. At the end of fermentation, the paste is drained and then pressed for 2 to 4 hours to remove excess water and reduce its moisture content. The pressed product is then crumbled and sieved through a 2 mm mesh sieve to obtain granules of homogeneous size and the characteristic texture of *gari*. The granules are then spread out in the shade and subjected to pre-drying for about 5 minutes before the roasting step. Roasting is carried out in a pan over a fire for 20 to 30 minutes, with continuous stirring, until a dry product with the characteristics of *gari* is obtained (Figure 7).

Regarding production fresh couscous, type *attieke* once preprocessing is complete, the mixture of cassava and white-fleshed sweet potato was subjected to fermentation at room temperature for about 24 hours. After fermentation, the paste is drained and then pressed for about 2 hours to remove excess water and obtain a paste of the appropriate consistency. The

pressed product is then crumbled and sieved to obtain a fine, homogeneous texture. This paste is then granulated, a process that involves placing it in a bowl and applying hand-tapping movements to form regular grains. The resulting grains are spread out in the shade for about 5 minutes for light drying before being steamed. This final step consists of steam cooking, which ensures gelatinization of the starch and gives *attieke* its characteristic texture. After cooking, the *attieke* is packed hot into airtight bags for storage and for physico-chemical and sensory analyses. This method produces an *attieke* made from white-fleshed sweet potatoes, as illustrated by the Figure 8.



Figure 7. *Dried couscous, gari type.*



Figure 8. *Fresh couscous, attieke type.*

2.4. Physicochemical Analyses

The physicochemical analyses were carried out at the physico-chemistry laboratory of the Food Technology Department (DTA) of IRSAT/Ouagadougou. These different analyses were carried out in duplicate. Replicates represent repeated measurements of the same batch.

2.4.1. pH Measurement

pH measurements of the *gari* and *attieke* samples were carried out by potentiometry using a pH meter according to AOAC method 945.10 (2000) [21]. Before use, the pH meter was calibrated using pH 4.7 and pH 10 buffer solutions.

2.4.2. Moisture Content

The water content of the *attieke* and *gari* formulations was determined according to ISO 665 (2020) [22] by drying at 105 ℃ ± 2 ℃ in an oven until a practically constant mass was obtained the operation according to the formula:

$$Moisture\ \left(\frac{g}{100g}FM\right) = \frac{PE-(Pf-P0)}{PE} \times 100 \qquad (1)$$

Pe = test load, Po = empty weight of the nacelles, Pf = final weight (nacelle + test load); FM = fresh material.

2.4.3. Determination of Acidity

Titratable acidity was determined by acid-base titration of a sample solution according to the AOAC method (2000) [23]. The free fatty acids present in the solution were assayed by titration with a 0.1 N sodium hydroxide (NaOH) solution. The amount of lactic acid present was determined using the following formula:

Titratable acidity (g lactic acid / 100 g FM) =

$$N\ x(V\text{-}Vb)\ x\ Vt/(VP\ x\ Pe)x\ 0.090\ \times 100 \qquad (2)$$

N: normality 0.1
V: volume of NAOH used in the titration
Vt: total volume of the sample
VP: volume of the test sample
Vb: volume of NAOH for the blank
Pe: test sample
FM: fresh material
0.090: Conversion factor (to lactiq acid)

2.4.4. Particle Size Determination

The particle size of the *attieke* and *gari* formulations was determined according to the method of Melcion (2000) [24]. The principle consists of separating the different particle-size fractions of a sample using a set of sieves and determining their proportions. The median particle size (MPS) is the sieve size through which more than 50 per cent of the sample passes. It was determined by calculating the percentage of the sample retained on each sieve using the formula below:

$$\%\ E = ((Mf - Mv)\ \times 100)/(Pe) \qquad (3)$$

Mf: Final mass (sieve containing part of the sample)
Mv: Empty mass of the sieve
% E: Percentage of the sample
Pe: Test portion

2.5. Determination of Nutritional Characteristics and Energy Value

Also, nutritional analyses were carried out at the physico-chemistry laboratory of the Food Technology Department

(DTA) of IRSAT/Ouagadougou. These different analyses were carried out in duplicate. Replicates represent repeated meas-urements of the same batch.

2.5.1. Determination of Fat Content

Fat content was extracted by the Soxhlet method using hexane as a solvent, according to ISO 659 (2009) [25]. The extraction was carried out hot (60 70 ℃) by soaking followed by rinsing the sample with hexane. The lipid content was determined by weighing after evaporation of the hexane using.

Procedure: Five grams (5g) of flour were weighed directly in a paper cartridge and covered with dehydrated cotton and placed in soxhlet extractors. In a 250 ml balloon, previously weighed (PV). 200 ml of hexane was introduced. The device is supplied with running water. The flask is gently heated to 60 ℃ - 70 ℃ for 4 hours. Each time the soxhlet fills with solvent, it siphons. That is, it flows back to the tank. After extraction, the solvent was evaporated with rotavapor. The flask containing the fat is placed in an oven for 1 hour to remove traces of solvent and then cooled with a desiccator. The flask is weighed (Pf) to constant weight and the fat content is expressed as a percentage by weight according to the following relationship:

$$\text{Fat (g/100g DM)} = [((Pf - Pv) \times 100) / (Pe)] \times 100 / (100\text{-}H) \quad (4)$$

Fat (g/100g DM): lipid content relative to dry matter;
Pf: final weight (ball + fat);
Pv: empty weight of the balloon;
Pe: test portion;
%H: percentage by mass of water previously determined
DM: Dry matter

2.5.2. Ash Content

Ash content was obtained according to ISO 2171 (2023) [26] by incineration at 550 ± 10 ℃ until complete combustion of the organic matter, followed by weighing of the resulting residue. This method consists of a differential weighing of the samples before and after dry mineralization. The calculation was performed using the following formula:

$$\text{Ash (g/100g DM)} = [((Pf\text{-}P0) \times 100)/Pe] \times 100/(100\text{-}H) \quad (5)$$

Ash (g/100g DM): ash content relative to dry matter
P0: Empty weight of the crucibles
Pf: Final weight (crucible + calcined sample)
PE: Test batch
DM: Dry matter
H: Water content

2.5.3. Protein Content

Total protein was determined according to ISO 1871 2009 [27] using the Kjeldahl method. This method is based on the determination of total nitrogen. The organic nitrogen of the samples to be analysed is converted into mineral nitrogen in ammoniacal form through the oxidizing action of concentrated boiling sulphuric acid in the presence of a catalyst. After displacement with sodium hydroxide, the ammonia is distilled and then titrated in the presence of a coloured reagent by acidimetry. The total protein content is calculated by multiplying the nitrogen content by a conversion factor (5.7), corresponding to 16% nitrogen in proteins. Procedure: In a Kjeldahl flask, 1 g of the sample (PE), a Kjeltabs catalyst pellet and 10 ml of concentrated sulfuric acid were introduced. The mixture was subjected to mineralization for 4 hours at 400 ℃ until a completely discolored solution was obtained. The mineralizat was then cooled and its volume will be completed to 50 ml with distilled water before being neutralized by a 40% NaOH solution. The neutralized solution is distilled and the ammonia solution collected in an Erlenmeyer flask. Distillation is stopped when the final volume in the Erlenmeyer flask reaches 150 ml. The distillate is then titrated with 0,1 N sulphuric acid solution until the colour indicator changes from green to pink. The volume of sulfuric acid (VE) is then recorded. A blank is made using the same procedure by replacing the sample with distilled water. The protein content was determined from the nitrogen content using the following formulas:

$$\text{Protein (g/100g DM)} = ([6{,}25 \times 0{,}014 \times 0{,}1 \times (Ve\text{-}Vb) \times 100] /Pe) \times 100/100\text{-}\%H \quad (6)$$

Protein (g/100 g/DM): protein content relative to dry matter
Ve: volume of acid at the equivalence point;
Vb: volume of the blank;
Pe: test sample.
%H: Moisture Content
Dry matter: DM

2.5.4. Determination of the Total Sugar Content

The total carbohydrate content was determined using the differential method Egan et al. [28] according to the formula:

$$\text{Carbohydrate (g/100 g DM)} = 100 - (\text{Water} + \text{Protein} + \text{Fat} + \text{Ash}) \quad (7)$$

2.5.5. Determination of the Energy Value

Energy value was calculated using the specific coefficients of Merrill and Watt [29], according to the following formula:

$$\text{Energy value (kcal/100 g)} = ((4 \times \%\ \text{Protein/DM}) + (4 \times \%\ \text{Total Carbohydrates/DM}) + (9 \times \%\ \text{Fat/DM})) \quad (8)$$

2.5.6. Sensory Analyses

Sensory analysis was carried out at the Food Technology Department (DTA) of IRSAT/Ouagadougou. For the three formulations of each product, three (03) combinations were required to reduce the first-order effect, resulting in 06 possible combinations. These six (6) combinations have been repeated three (3) or four (4) times and result in 18 and 24 tasters depending on their availability for the statistical evaluation of product preference. In pratice, the dried couscous (*gari*-style) was tasted by a panel of 19 tasters, whilst the fresh couscous (*attieke*-style) was tasted by 24 tasters, comprising men and women aged over 15, including students from several universities and staff members of the DTA. Samples were coded using a combination of three (03) digits to avoid data bias. These codes were chosen from the Cochran and Cox random allocation table [30].

The samples were placed in bowls and set out on trays by combination, together with a sachet of water for rinsing the mouth between two samples and the evaluation form.

Sensory test

Three (03) tests were selected for the sensory analysis, namely the sensory profile, the hedonic test and the ranking test. All methods were carried out in accordance with current guidelines and regulations. The three tests were conducted simultaneously.

The sensory profile was assessed in accordance with ISO 11035 (ISO, 1995). The aim of this test was to describe the products and assign an identity to each one. Panelists were asked to describe the colour, appearance, texture, odour and taste using 5-point scales, as summarised in Table 1.

The hedonic tests were used to measure the degree of liking for the protein curd samples by selecting the appropriate category (Table 2 & Table 3). The tasters were asked to rank the samples at the end of the hedonic test [31]. The evaluation criteria are summarised in Table 2 and Table 3.

Table 2. *Descriptors, parameters and assessment scores for couscous gari type.*

Sensory descriptors	*Gari* type couscous parameter	Assigned grades
Color	Bright white	5
	White	4
	Dirty white	3
	Grey	2
	Dark gray	1
Appearance	Very beautiful	5
	Beautiful	4
	Quite beautiful	3
	Fairly beautiful	2
	Not beautiful	1
Smell	Highly fermented	5
	Fermented	4
	Quite fermented	3
	Moderately fermented	2
	Not fermented	1
Taste	Very pleasant	5
	Pleasant	4
	Quite pleasant	3
	Unpleasant	2
	Very unpleasant	1
Acidity	Very acidic	5

Sensory descriptors	*Gari* type couscous parameter	Assigned grades
	Acid	4
	Quite acidic	3
	Slightly acidic	2
	Not acidic	1
	Not bitter	5
	A little bitter	4
Aftertaste	Quite bitter	3
	Bitter	2
	Very bitter	1
	Very heterogeneous	5
	Heterogeneous	4
Particle heterogeneity	Fairly homogeneous	3
	Homogeneous	2
	Very homogeneous	1
	Very coarse	5
	Coarse	4
Particle size	Fairly coarse	3
	Small	2
	Very small	1
	Very pronounced	5
	Pronounced	4
Sweet potato taste sensation	Quite pronounced	3
	Slightly pronounced	2
	Very dry	1
	Dry	5
Degree of drying	Quite dry	4
	A little dry	3
	Not dry	2
	Very sweet	1
	Sugar	5
	Quite sweet	4
Sweet taste	Slightly sweet	3
	Not sweet	2
	Absent	1
	I like it very much	5
	I like	4
Hedonic	Indifferent	3
	I like it a little	2
	I don't like it at all	1

Sensory descriptors	*Gari* type couscous parameter	Assigned grades
Ranking	Rank 1	1
	Rank 2	2
	Rank 3	3

Table 3. *Descriptors, parameters and assessment scores for couscous Attieke type.*

Sensory descriptors	*Attieke* type couscous parameter	Assigned grades
Color	Bright white	5
	White	4
	Dirty white	3
	Grey	2
	Dark gray	1
Appearance	Very beautiful	5
	Beautiful	4
	Quite beautiful	3
	Fairly beautiful	2
	Not beautiful	1
Smell	Very good	5
	Good	4
	Pretty good	3
	Fairly good	2
	Not good	1
Taste	Very pleasant	5
	Pleasant	4
	Quite pleasant	3
	Quite pleasant	2
	Unpleasant	1
Acidity	Very acidic	5
	Acid	4
	Quite acidic	3
	Slightly acidic	2
	Not acidic	1
Particle size	Very coarse	5
	Coarse	4
	Fairly coarse	3
	Small	2
	Very small	1
Sweet potato taste sensation	Very pronounced	5

Sensory descriptors	*Attieke* type couscous parameter	Assigned grades
	Pronounced	4
	Quite pronounced	3
	Slightly pronounced	2
	Absent	1
	I like it very much	5
	I like	4
Hedonic	Indifferent	3
	I like it a little	2
	I don't like it at all	1
	Rank 1	1
Ranking	Rank 2	2
	Rank 3	3

2.6. Data Analysis

The Excel workbook was used for entering data on physico-chemical and sensory parameters, calculating averages and standard deviations. The statistical analysis of sensory test data was carried out using XLSTAT software. Turkey was used to compare statistical averages of data with a significance level of 5% and a confidence level of 95%. For the sensory profile, the average and standard deviations of the notes were calculated for each formulation.

3. Results

3.1. Physicochemical and Nutritional Characteristics of Dried Couscous *(Gari*-type)

Table 4 presents the physicochemical and nutritional characteristics of *gari*.

Table 4. *Physicochemical and nutritional characteristics of gari.*

Physicochemical parameter	GP100	GP50M50	GP75M25	Pr > F
Moisture (g/100g FM)	4.59 ±0.02^{a}	9.20 ±0.01^{d}	8.54 ±0.05^{c}	0.0001
pH	3.535 ±0.01^{a}	4.04 ±0.04^{c}	3.70 ±0.07^{b}	0.0036
Titratable acidity (g lactic acid / 100 g FM)	7.31 ±0.43^{b}	3.98 ±0.21^{a}	3.99 ±0.22^{a}	0.0024
Ash (g/100g DM)	2.18 ±0.05^{a}	2.47 ±0.32^{a}	2.01 ±0.06^{a}	0.1941
Protein (g/100g DM)	5.33 ±0.09^{c}	3.17 ±0.09^{a}	3.81 ±0.13^{b}	0.0005
Fat (g/100g DM)	0.12 ±0.01^{a}	0.12 ±0.00^{a}	0.18 ±0.00^{b}	0.001
Carbohydrates (g/100g DM)	92.36 ±0.04^{a}	94.24 ±0.41^{b}	94.01 ±0.07^{b}	0.0082
Energy values (Kcal/100g DM)	391.88 ±0.16^{a}	390.75 ±1.29^{a}	392.88 ±0.22^{a}	0.1453

Values without an identical superscript letter within a row are considered significantly different ($p < 0.05$).
Legend: GP50M50: *gari* made from 50% sweet potato and 50% cassava; GP75M25: *gari* made from 75% sweet potato and 25% cassava; GP100: *gari* made from 100% sweet potato.

The water content, pH and acidity of the different *gari* formulations ranged respectively from 4.59 to 9.20 g/100 g DM; 3.53 to 4.04; and 3.98 to 7.31 g/100 g DM. The highest acidity and lowest pH were found in the GP100 formulation. Statistical analyses indicate a significant difference between the water content, pH and acidity values.

The analyses also indicate a significant difference between the protein, fat and carbohydrate contents (g/100 g DM) of the different formulations, with values ranging respectively from 3.17 to 5.33; 0.12 to 0.18; and 92.36 to 94.24. Ash content ranged from 2.01 to 2.47 g/100 g dry matter (DM), while energy values ranged from 390.75 to 392.88 kcal/100 g DM. The results show that there is no significant difference between the ash content and energy values of the different samples.

The highest protein content was observed in the GP100 formulation and the lowest in the GP50M50 formulation.

Table 5 presents the particle size distribution of the different *gari* formulations.

Table 5. *Particle size distribution of gari grains.*

Sample	Grain diameter	Proportion (%)	Size
GP50M50	> 1.4 mm	20 ±6.36	Large
	1.4mm > d > 1 mm	31 ±4.24	Medium
	1 mm > d > 450 µm	48 ±9.90	Small
	450 µm > d > 250 µm	0.8 ±0.57	Very fine
	< 250 µm	0.2 ±0.00	Extra fine
GP75M25	> 1.4 mm	38.1 ±1.27	Large
	1.4mm > d > 1 mm	35.7 ±5.80	Medium
	1 mm > d > 450 µm	26.4 ±8.49	Small
	450 µm > d > 250 µm	0.2 ±0.00	Very fine
	< 250 µm	0.1 ±0.14	Extra fine
GP100	> 1.4 mm	44.7 ±4.95	Large
	1.4mm > d > 1 mm	36.3 ±1.27	Medium
	1 mm > d > 450 µm	18.6 ±5.94	Small
	450 µm > d > 250 µm	0.2 ±0.28	Very fine
	< 250 µm	0.2 ±0.14	Extra fine

The particle size of GP50M50 *gari* was characterized by smaller particles, while the GP75M25 and GP100 samples had larger particles. This observation suggests that an increase in the proportion of sweet potato in the formulation promotes an increase in the size of *gari* granules. This phenomenon could be attributed to the highwater content of sweet potato, which promotes particle agglomeration during processing and leads to the formation of larger granules.

3.2. Organoleptic Characteristics of Dried Couscous (*Gari*-type)

3.2.1. Sensory Profile of Dried Couscous (*Gari*-type)

Table 6 present the sensory profiles and the comparison of mean sensory parameters.

Table 6. *Sensory profile of gari formulations.*

Sensory parameter	GP75M25	GP50M50	GP100	Pr > F
Appearance	3.83 ±1.03^{a}	2.79 ±0.99^{b}	3.15 ±0.99^{ab}	0.009
Colour	3.06 ±0.88^{a}	2.00 ±1.06^{b}	2.40 ±0.75^{ab}	0.003

Sensory parameter	GP75M25	GP50M50	GP100	Pr > F
Odour	2.33 ±1.03[a]	2.21 ±1.19[a]	2.20 ±1.11[a]	0.921
Acidity	2.44 ±1.12[b]	3.42 ±1.10[a]	2.65 ±0.99[ab]	0.018
Taste	4.17 ±0.50[a]	3.63 ±0.38[b]	3.90 ±0.55[ab]	0.006
Aftertaste	4.83 ±0.84[a]	4.58 ±0.38[a]	4.60 ±0.60[a]	0.411
heterogeneity	3.28 ±0.76[a]	3.63 ±0.83[a]	3.05 ±1.00[a]	0.121
Particle size	2.50 ±0.60[a]	2.84 ±0.51[a]	2.55 ±0.69[a]	0.185
Sweet-potato taste sensation	2.22 ±1.16[a]	2.32 ±1.11[a]	1.80 ±0.95[a]	0.287
Degree of drying	4.28 ±0.85[a]	4.21 ±0.75[a]	4.00 ±0.79[a]	0.537
Sweetness	1.33 ±0.77[a]	1.42 ±0.59[a]	1.30 ±0.66[a]	0.849
Hedonic score)	4.33 ±1.02[a]	3.47 ±0.84[b]	3.85 ±1.04[ab]	0.034

The statistical results revealed that the tasters detected no significant differences between the three *gari* formulations in terms of odour, aftertaste, particle heterogeneity, particle size, perceived sweet potato flavour, degree of drying and sweetness. For all three *gari* formulations, the tasters considered the odour to be non-fermented, with average scores ranging from 2.20 ±1.11 to 2.33 ±1.03. They also described the aftertaste of the three formulations as not bitter, with average scores ranging from 4.58 ±0.38 to 4.83 ±0.84.

The particle size of the different *gari* formulations was judged to be fairly uniform, with average scores ranging from 3.05 ±1.00 to 3.63 ±0.83. Furthermore, the tasters rated the particles as small, with average scores ranging from 2.50 ± 0.60 to 2.84 ±0.51. The tasters considered that the characteristic sweet potato flavour was absent in the various formulations, awarding them average scores ranging from 1.80 ±0.95 to 2.32 ± 1.11. As regards the degree of drying, the tasters considered that the three formulations were well dried, awarding them average scores ranging from 4.00 ±0.79 to 4.28 ± 0.85. Finally, the natural sweetness present in fresh sweet potatoes was not detected in the finished products. Indeed, the tasters reported a lack of sweetness in all three formulations, with average scores ranging from 1.30 ±0.66 to 1.42 ±0.59.

With regard to the other sensory parameters, such as appearance, colour, sourness, taste and hedonic rating, the results of the analysis show a significant difference between the samples. The GP50M50 sample was described by the tasters as having an attractive appearance, an off-white colour, a slightly tart taste (31.6 per cent of tasters) and a pleasant taste, with average scores of 2.79 ±0.99; 2.00 ±1.06; 3.42 ±1.10; and 3.63 ±0.38. The GP75M25 sample was described by the tasters as having an attractive appearance, a grey colour, a slightly tangy taste and a pleasant taste, with respective average scores of 3.83 ±1.03; 3.06 ±0.88; 2.44 ±1.12; and 4.17 ±0.50. The GP100 sample was described by the tasters as having a fairly pleasant appearance, a off-white colour, a tangy taste and a pleasant flavour, with average scores of 3.15 ±0.99; 2.40 ±0.75; 2.65 ±0.99; and 3.90 ±0.55 respectively.

3.2.2. Hedonic of Dried Couscous (*Gari*-type)

The results of the hedonic and ranking test are shown in Figure 9.

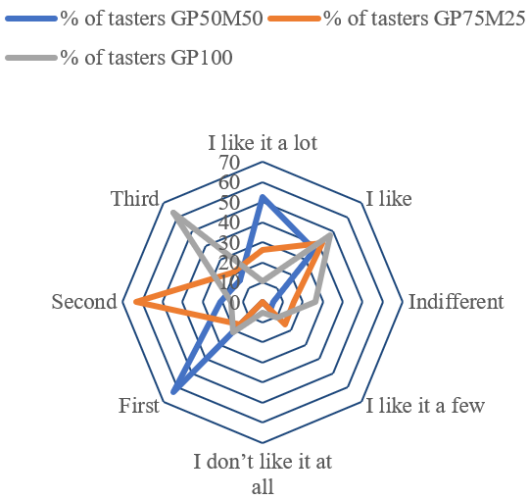


Figure 9. *Hedonic and ranking test of gari.*

The results showed a significant difference in the tasters' hedonic ratings between the three *gari* formulations (Table 6). The GP50M50 sample was the most popular. Indeed, 52.6 per cent and 36.8 per cent of the tasters 'really liked' and 'liked' it respectively. For the GP75M25 sample, 26.3 per cent of the tasters said they 'really liked' it, whilst 42.1 per cent said they 'liked' it. In contrast, the GP100 sample received the lowest levels of approval, with 10.5 per cent of tasters 'really liking' it and 47.4 per cent 'liking' it. The tasters ranked the

GP50M50 *gari* in first place, followed by the GP75M25 in second place and the GP100 in third place. This ranking indicates that tasters' preferences vary depending on the formulation. An increase in the proportion of sweet potato in the *gari* led to a decrease in tasters' preference. However, all formulations were generally well received.

3.3. Physicochemical and Nutritional Characteristics of Fresh Couscous, *Attieke* - type

Table 7 presents the physicochemical and nutritional characteristics of the *attieke* formulations, and Table 8 presents the particle size distribution of the *attieke* samples.

Table 7. *Physicochemical and nutritional characteristics of attieke.*

Physicochemical and nutritional parameter	AP50M50	AP75M25	AP100	Pr > F
pH	3.90 ±0.00^{a}	3.63 ±0.00^{b}	3.62 ±0.00^{b}	0.000
Acidity (g lactic acid / 100 g FM)	2.23 ±0.00^{a}	2.63 ±0.01^{b}	2.63 ±0.01^{b}	0.0353
Moisture (g/100g FM)	51.19 ±0.20^{c}	59.37 ±0.26^{a}	56.83 ±0.57^{b}	0.000
Ash (g/100g DM)	1.21 ±0.02^{a}	1.04 ±0.00^{a}	1.05 ±0.05^{a}	0.1510
Fat (g/100g DM)	0.12 ±0.00^{a}	0.10 ±0.01^{a}	0.10 ±0.02^{a}	0.5999
Protein (g/100g DM)	2.92 ±0.01^{a}	3.71 ±0.02^{c}	3.49 ±0.00^{b}	0.0006
Carbohydrates (g/100g DM)	95.73 ±0.01^{b}	95.13 ±0.04^{a}	95.39 ±0.16^{b}	0.0213
Energy values (Kcal/100g DM)	395.73 ±0.16^{a}	396.34 ±0.05^{a}	396.45 ±0.65^{a}	0.2839

Values without an identical superscript letter within a row are considered significantly different ($p < 0.05$).
Legend: AP50M50: *attieke* made from 50% sweet potato and 50% cassava; AP75M25: *attieke* made from 75% sweet potato and 25% cassava; AP100: *attieke* made from 100% sweet potato.

Table 8 presents the particle size distribution of the different *attieke* formulations.

Table 8. *Particle size distribution of attieke grains.*

Sample	Grain diameter	Proportion (%)	Size
AP50M50	> 1.4 mm	39.2 ±5.94	Large
	1.4mm > d > 1 mm	30 ±0.85	Medium
	1 mm > d > 450 µm	16.4 ±3.68	Small
	450 µm > d > 250 µm	7.2 ±0.28	Very fine
	< 250 µm	7.2 ±0.00	Extra fine
AP75M25	> 1.4 mm	37.6 ±10.75	Large
	1.4mm > d > 1 mm	20.8 ±3.68	Medium
	1 mm > d > 450 µm	16.2 ±0.28	Small
	450 µm > d > 250 µm	13.2 ±0.00	Very fine
	< 250 µm	12.2 ±0.00	Extra fine
AP100	> 1.4 mm	59.3 ±0.71	Large
	1.4mm > d > 1 mm	25.2 ±0.85	Medium
	1 mm > d > 450 µm	13.5 ±0.14	Small
	450 µm > d > 250 µm	2 ±0.14	Very fine

Sample	Grain diameter	Proportion (%)	Size
	< 250 µm	0 ± 0.00	Extra fine

Statistical analyses indicate a significant difference between the water, pH and acidity contents of the different *attieke* formulations, with values ranging respectively from 51.19 to 59.37 g/100 g FM; 3.62 to 3.90; and 2.23 to 2.63 g/100 g DM. The highest acidity and lowest pH were found in the AP100 formulation.

Regarding the particle size distribution of *attieke* formulations, this table shows that all samples AP50M50, AP100, and AP75M25 are all large sizes.

The analyses also indicate a significant difference between the protein and carbohydrate contents (g/100 g DM) of the different formulations, ranging respectively from 2.92 to 3.71 and from 95.13 to 95.73. The highest protein content was observed in the AP75M25 formulation and the lowest in the AP50M50 formulation. However, the results show no difference between the ash content, fat content and energy values of the samples, which ranged respectively from 1.04 to 1.21 g/100 g DM, 0.10 to 0.12 g/100 g DM, and 395.73 to 396.34 kcal/100 g DM.

3.4. Organoleptic Characteristics of Fresh Couscous, *Attieke* -type

3.4.1. Sensory Profile of Fresh Couscous (*Attieke*-type)

Table 9 present the sensory profiles of the three *attieke* formulations and the comparison of their mean sensory parameters.

Table 9. *Sensory profile of attieke formulations.*

Sensory parameter	AP50M50	AP75M25	AP100	Pr > F
Appearance	3.96 ± 0.99^{a}	3.96 ± 0.66^{a}	3.00 ± 0.62^{b}	0.000
Colour	3.46 ± 0.83^{a}	3.33 ± 0.93^{a}	2.54 ± 0.70^{b}	0.000
Odour	3.50 ± 0.72^{ab}	3.75 ± 0.80^{a}	3.13 ± 0.79^{b}	0.023
Taste	3.67 ± 0.64^{a}	3.58 ± 0.65^{a}	3.37 ± 0.83^{a}	0.347
Acidity	3.46 ± 1.18^{a}	2.04 ± 1.2^{b}	3.29 ± 0.86^{a}	0.000
Texture	3.08 ± 0.72^{a}	3.13 ± 0.70^{a}	2.83 ± 0.74^{a}	0.322
Perception of sweet-potato taste	1.80 ± 0.95^{a}	1.83 ± 1.13^{a}	1.83 ± 1.09^{a}	0.988
Hedonic score	3.46 ± 1.18^{a}	3.75 ± 1.30^{a}	3.04 ± 1.19^{a}	0.139

Values without an identical superscript letter within a row are considered significantly different ($p < 0.05$).

The statistical results revealed that the tasters detected no significant difference between the three *attieke* formulations in terms of taste, texture and the perceived flavour of sweet potato. Indeed, for all three *attieke* formulations, the tasters rated the flavour as pleasant, with average scores ranging from 3.37 ± 0.83 to 3.67 ± 0.64. Furthermore, they considered the particles to be of medium size, corresponding to average scores ranging from 2.83 ± 0.74 to 3.13 ± 0.70. Finally, they reported a marked absence of sweet potato flavour, corresponding to average scores ranging from 1.80 to 1.83.

With regard to the other sensory parameters of *attieke*, such as appearance, colour, odour and tangy taste, the results of the analysis show a significant difference between the samples. The AP50M50 sample was described by the tasters as having an attractive appearance, an off-white colour, a pleasant smell and a slightly tangy taste, corresponding to average scores of 3.96 ± 0.99, 3.46 ± 0.83, 3.50 ± 0.72 and 3.46 ± 1.18 respectively.

Sample AP75M25 was described by the majority of tasters as having an attractive appearance, a white colour, a good aroma and a rather acidic taste, with average scores of 3.96 ± 0.66, 3.33 ± 0.93, 3.75 ± 0.80 and 2.04 ± 1.2 respectively.

Sample AP100 was described by the majority of tasters as having an attractive appearance, a off-white colour, a pleasant aroma and a rather acidic taste, with average scores of 3.00 ± 0.62, 2.54 ± 0.70, 3.13 ± 0.79 and 3.29 ± 0.86 respectively.

3.4.2. Hedonic of Fresh Couscous (*Attieke*-type)

The results of the hedonic and ranking test are shown in Figure 10.

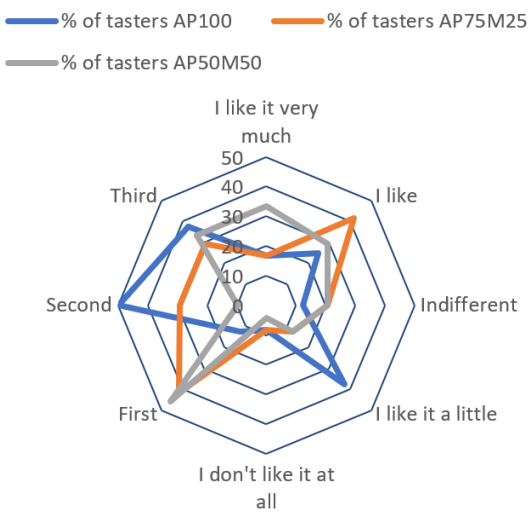


Figure 10. *Hedonic and ranking test of attieke.*

The results showed no significant difference in tasters' hedonic appreciation between the three formulations (Table 8). Indeed, for the AP50M50 sample, 33.3% of tasters said they "liked it a lot" and 29.2% "liked" it. For the AP75M25 sample, 16.7% of tasters "liked it a lot" and 41.7% "liked" it. Finally, for the AP100 sample, 16.7% of tasters said they "liked it a lot", while 25.0% "liked" it.

Attieke formulated from 50% sweet potato and 50% cassava (AP50M50) was ranked first by tasters, followed by the AP75M25 sample, while the AP100 sample was ranked third. This preference could be explained by the fact that the formulations combining sweet potato and cassava have organoleptic characteristics particularly in terms of taste, texture and odour closer to those of traditional *attieke*.

4. Discussion

The water content of the three *gari* formulations is close to that reported by Akely and al. [32], who found water contents for *gari* ranging from 4.49% to 10.24%. The water contents of the different *gari* formulations comply with the FAO [33] recommendation, which sets a maximum water content of 12.0% for this product. The low water content observed across all *gari* formulations can be attributed to the effectiveness of the roasting process, which promotes a substantial reduction in moisture. This low moisture content is an essential factor for product preservation, as it limits the development of microorganisms and slows spoilage reactions, thereby helping to extend shelf life.

The acidity levels and pH values of the three *gari* formulations are respectively higher and lower than those of cassava *gari*. The low pH and high acidity of the three *gari* formulations may be attributed to extensive fermentation resulting from the high sugar content of sweet potato compared to cassava, which produces organic acids. The acidity levels of the *gari* are higher than those observed by Kegah & Ndjouenkeu [34], who obtained acidity levels ranging from 0.7 to 3.2%, and than those observed by Oduro et al. [35], who found contents ranging from 0.63% to 1.55% in cassava *gari*. The pH values of the three *gari* formulations are slightly lower than those of cassava *gari* reported by Adedola et al. [36], who found values ranging from 5.73 ±0.01 to 6.51 ±0.01 in their study.

The ash and protein contents of the three *gari* formulations are higher than those of cassava *gari*. These higher mineral contents can be explained by the addition of sweet potato, which contains more protein and micronutrients than cassava. Ash content is an indicator of the total amount of minerals present in the food. The ash contents of the three *gari* formulations are higher than those reported by Atuna et al. [37], who found ash contents for cassava *gari* ranging from 1.28 ±0.04% to 1.93 ± 0.03%. These contents are also higher than those found by Adepoju et al. [38], who found values ranging from 1.89 ±0.10 to 2.15 ±0.30%. The protein contents are higher than those reported by Atuna et al. [37], who found protein contents for cassava *gari* ranging from 1.37 ±0.10 to 1.58 ± 0.15%. They are also higher than those found by Adepoju et al. [38] of 1.5 ±0.01% for cassava *gari*.

The particle size of the *gari* formulations depends on the proportion of sweet potato. This indicates that the higher the proportion of sweet potato in the formulation, the larger the *gari* particle size tends to be, since sweet potato has a high water content that promotes the formation of coarser grains. These results are higher than those of Ahouansou et al. [39], who worked on cassava-based *gari* and found a particle size below 1.3 mm.

Fat content was low across all three *gari* formulations, while carbohydrate content was high. Their fat content is lower than that reported by Adepoju et al. [38], which was 0.3 ± 0.02 to 0.6 ± 0.02% for cassava *gari*. Olayinka et al. [40] also obtained a higher fat content for cassava *gari*, ranging from 1.31 ±0.01% to 2.11 ±0.05%. Sweet potato and cassava are both very low in fat. However, it is noted that cassava contains more fat than sweet potato.

Their carbohydrate contents are higher than those found by Akely et al. [32], who reported a slightly lower carbohydrate content for *gari*, ranging from 86.34% to 90.89%. This can be explained by the addition of sweet potato, which contains more sugar than cassava.

The energy values of *gari* are higher than those found by Adedola et al. [36], who obtained values ranging from 357.60 to 391.80 kcal.

The difference observed in the sensory tests with respect to appearance, colour, sourness and taste of the three *gari* formulations is related to the cassava content of the formulation. An increase in cassava content makes the colour lighter and more

attractive. The colour of the samples evolves from dark grey for the GP100 sample to dirty white for the GP50M50 sample. The grey colour may be linked to the phenomenon of oxidation or enzymatic browning of the sweet potato in the formulation upon contact with atmospheric oxygen. Indeed, after the sweet potato is cut, the cells are broken, releasing enzymes that come into contact with atmospheric oxygen to form a phenolic compound and produce melanin, a dark pigment (brown to black). The higher the proportion of sweet potato, the more sour tasters find the *gari*. The slightly sour taste of GP75M25 was the most appreciated and went hand in hand with hedonic acceptability. However, all three formulations were liked by the tasters.

As for the *attieke* samples, the pH and acidity levels comply with the values defined by the Burkinab è standard NBF 01-230 [41] on *attieke*, which recommends a pH of 3.5 to 5 and an acidity between 0.9 and 4.5 g lactic acid/100 g *attieke*. These pH values are close to those found by Dededji et al. [42], which was 4.4 ± 0.2, and by Regina et al. [43], which was 4.4 ± 0.1 for cassava *attieke*. Relatively low pH levels inhibit the growth of many pathogenic and spoilage micro-organisms, thereby helping to slow food deterioration [44]. These acidity values are also lower than those reported by Assunta [45] for cassava *attieke*, which was 4.29 ± 0.06 meq/100 g. Titratable acidity plays an essential role in food safety by inhibiting the proliferation of spoilage and/or pathogenic micro-organisms [46].

Fat content was low across the three *attieke* formulations, while ash, protein and carbohydrate content were high. This can be explained by the nutritional composition of the sweet potato and cassava used to prepare the *attieke* formulations. Ash and fat contents also complied with the values defined by the Burkinab è standard NBF 01-230 [41] on *attieke*, which recommends ash content below 1.4% of dry matter and fat content below 3%.

The particle sizes of the *attieke* formulations are similar to those obtained by Assanvo et al. [47] for three types of cassava *attieke*, which were 1.50 mm ≤ Ø < 2.00 mm; this could be explained by the fact that white sweet potato has a high water content that promotes the formation of coarser grains.

Attieke formulations with high carbohydrate content would constitute a good source of energy for the body. The carbohydrate contents obtained in the different formulations are close to those reported by Zongo et al. [48], who observed, for fermented couscous made from orange-fleshed sweet potato (OFSP), carbohydrate contents ranging from 95.21 ± 0.08% to 97.2 ± 0.1% of dry matter, and to those obtained by Assunta [45], which ranged from 92.73 ± 0.15% to 94.15 ± 0.14% DM for cassava *attieke*.

Protein contents are close to those obtained by Assanvo et al. [47] (2019) for cassava-based *attieke* (3.02 ± 1.33% DM). The Burkinab è standard NBF 01-230 [41] relating to fresh *attieke* does not specify a value for protein content.

Energy values were higher than those obtained by Assunta [45] for cassava *attieke*, which was 384.88 ± 0.29 kcal/100 g DM, and close to those of Yeboue et al. [49], which was 396.93 ± 0.10 kcal/100 g DM.

The difference observed in sensory tests among the three *attieke* formulations with respect to appearance, colour, odour and sourness is also related to the sweet-potato content of the formulation. Increasing the proportion of sweet potato makes the colour less white, and it is judged to be fairly nice. The colour changes from dirty white for the AP100 sample to white for AP50M50. The dirty-white colour may be linked to the phenomenon of oxidation or browning of the sweet potato in the formulation upon contact with atmospheric oxygen. The higher the proportion of sweet potato, the more sour tasters find the *attieke*. The slightly sour taste of the AP50M50 sample was the most appreciated by tasters, which is consistent with its high level of hedonic acceptability. Nevertheless, all three formulations were generally well appreciated by the tasters as a whole.

5. Conclusions

This study characterized the physico-chemical, nutritional and organoleptic properties of *gari* and *attieke* enriched with different proportions of white-fleshed sweet potato. These *attieke* and *gari* formulations obtained have acceptable physico-chemical, nutritional and organoleptic characteristics when compared to standards. GP50M50 obtained the best hedonic preference among the *gari* samples, while AP50M50 ranked first among the *attieke* samples, but the observed hedonic differences for the *attieke* were not statistically significant. Although protein and fat contents remained relatively low, which is characteristic of this type of product, the incorporation of sweet potato had a significant impact on the nutritional profile of the formulations. It thus makes it possible to improve the nutritional value of the products while maintaining good sensory acceptability. Acidification of *gari* and *attieke* through fermentation was confirmed by the pH and titratable acidity values. However, additional analyses such as water activity and microbiological analysis must be added to the low levels of humidity and pH to ensure the microbiological safety of the samples. Analyses of micronutrients or bioactive compounds should also be carried out to supplement the nutritional composition of these new products. This is a limit of our study that we plan to resolve in our next study. The appearance and colour of both types of products were darkened by the addition of sweet potato from 75% onward, which certainly caused enzymatic browning. To improve appearance, it would be useful to improve the process by avoiding oxidation of the tubers after cutting. Processing cassava tubers into *attieke* and *gari* is an advantageous practice, not only for good product preservation but also for improving the nutritional quality of the food.

Abbreviations

DM	Dry Matter
WFSP	White-Fleshed Sweet Potato

ISO International Organisation for Standardisation

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Author Contributions

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Edwige Bahanla Oboulbiga: Writing – review & editing

Larissa Yacine Ware: Writing – review & editing

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography



Rasmata Dabo is a Research Fellow in the Food Technology Department at the Institute for Research in Applied Sciences and Technologies (IRSAT) at the National Centre for Scientific and Technological Research (CNRST) in Burkina Faso. She obtained her DESS in Agri-Food Industry in 2011, her Master II in Human Nutrition and Food Toxicology in 2019 and her PhD in Human Nutrition and Food Toxicology in 2024, all from the same university, Joseph Ki-Zerbo University (UJKZ) in Ouagadougou, Burkina Faso. She has been involved in the design and implementation of activities for several national and international research projects. She has presented papers at scientific conferences. She also contributes to the supervision of students.



Zoenabo Douamba is a senior research fellow in the Department of Food Technology at the Institute for Research in Applied Sciences and Technologies (IRSAT) in Burkina Faso. She obtained her DEA (postgraduate diploma) in Biochemistry and Molecular Biology in 2012 from the University of Ouagadougou (UO), her supplementary Master's degree in Food Science in 2016 from the University of Louvain-la-Neuve in Belgium, and her PhD in Biochemistry and Molecular Biology in 2017 from the UO. She has been involved in the development and implementation of activities for several national and international research projects. She has chaired and reported on scientific meetings. She also contributes to the supervision of students.



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Larissa Yacine Ware is a research fellow in the Department of Food Technology at the National Centre for Scientific and Technological Research of Burkina Faso. She obtained her PhD in Biochemistry and Microbiology from Joseph Ki-Zerbo University in 2018, her Master's II in Microbial and Cellular Biotechnology from the University of Ouagadougou in 2010, and her Master's degree in Food Technology and Human Nutrition from the University of Ouagadougou in 2009. In recognition of her outstanding contributions, Dr WARE was awarded the title of Research Fellow in 2022 by the African and Malagasy Council for Higher Education. In recent years, she has co-authored several articles in scientific journals and presented numerous oral and poster presentations at conferences, covering topics such as food safety, mycotoxins and food processing practices. She has also participated in conferences as a moderator and rapporteur, contributing to discussions on scientific research and technological innovations.

Research Field

Rasmata Dabo: Child and community nutrition, Agri-food processing, Food fortification, the nutritional, antioxidant and health properties of vegetable oils, particularly sesame oil, the development of the sweet potato, cassava and moringa sectors through the creation of new food product, the sensory acceptability of local cowpea varieties and complementary feeding practices for young children, the dietary typology of traditional dishes in different regions of Burkina Faso.

Zoenabo Douamba: grain processing technology, vegetable and legume processing technologies, non-wood forest products processing technology, root and tuber processing technology, microbiology of local fermented products, identification of dietary miRNA.

Edwige Bahanla Oboulbiga: the nutritional, physicochemical and health characterisation of food, the optimisation of local food resources, processing and preservation technologies for agri-food products; and the nutritional quality and food safety of food, the processing of sesame, tomatoes and sweet potatoes to develop innovative food products and improve food and nutritional security.

Larissa Yacine Ware: technology and Food Safety, infant formulae and food supplements, microbiological and biochemical characterisation, Promotion of local produce.