

Research Article

PHYSICO-CHEMICAL CHARACTERIZATION OF LOCAL VARIETIES OF GROUNDNUT AND COWPEA IN THE SUDANIAN ZONE OF CHAD

^{1*}Touroumgaye GOALBAYE, ¹Mansour HASSANE, ²Moussa Ngarena KLAMADJI, ¹Alhadj MARKHOUS NAZAL, ¹Ahmat Amine CHERIF, ¹Ganda Adoum MALATO, ¹Grace SOLO YASSI

¹Université de Sarh BP 105 Sarh, Tchad.

²Université de Pala BP 20 Pala, Tchad.

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ABSTRACT

In Chad, producers use seeds from mass selection without knowing their nutritional values. The objective of the study is to determine the physicochemical characteristics of peanuts and cowpeas. The plant material consists of local varieties. Samples containing 100 g of seeds each were collected and analyzed using spectroscopy with non-destructive and dispersive fluorescence. The iron content of peanuts from the villages of Kemdéré and Maïbo is 1.8 mg and 2.6 mg, respectively. The iron content of peanuts from Maïbéssé and Ngonbégulaye is 1.05 mg and 1.40 mg, respectively. The lipid content of Kemdéré and Maïbo is 42.15% and 44.05%. Those of Maïbéssé and Ngonbégulaye are 42.10% and 43.06%. The protein content of Kemdéré and Maïbo is 25.40% and 25.32%, while that of Maïbéssé and Ngonbégulaye is 25.25% and 26.15%. The carbohydrate content of Kemdéré and Maïbo is 16.05% and 17.10%. Those from Maïbéssé and Ngonbégulaye are 16.22% and 16.52%. The iron content of cowpeas from the villages of Kemdéré and Maïbo is 5.03mg and 5.25mg. Those of Maïbéssé and Ngonbégulaye are 5.13mg and 6.05mg. The lipid content of Kemdéré and Maïbo is 1.05% and 1.15%. Those of Maïbéssé and Ngonbégulaye are 0.90% and 1.02%. The protein content of cowpeas from Kemdéré and Maïbo is 21.15% and 22.05%. Those from Maïbéssé and Ngonbégulaye are 21.20% and 22.15%. The carbohydrate content of Kemdéré and Maïbo is 60.25% and 61.05%. Those of Maïbéssé and Ngonbégulaye are 61.35% and 62.22%. The nutritional values of the local varieties grown by these producers are below limit values; to this end, they must also use improved varieties.

Keywords: nutritional values, seeds, local varieties, *Arachis hypogea* L, *Vigna unguiculata* L, Chad.

INTRODUCTION

The FAO estimated that 750 million people are severely food insecure, representing nearly one in ten people worldwide. In total, 2 billion people do not have regular access to safe, nutritious, and sufficient food [1]. Food security and poverty reduction have become major concerns for most countries around the world [2].

Chad's agricultural policy is to ensure food security for the population with high-quality, low-cost agricultural products on a sustainable basis [3] and to contribute to poverty reduction in rural areas. However, producers face problems with seeds that have low nutritional value. They use seeds from mass selection without knowing their nutritional value. These seeds are generally of poor quality because they do not make a judicious choice of crop varieties [4].

When it comes to seeds with nutritional value, this is a major problem worldwide. Solutions vary depending on the level of technical expertise among farmers and how seed production is organized at the national level. In the US and Israel, selected seeds are delivered packaged and ready to sow [5], which guarantees their nutritional quality. In many countries, the task of producing and storing seeds is left to the initiative of farmers, which sometimes leads to the use of poor-quality seeds [6].

To this end, farmers are forced to use seeds from the market, the genetic identity, varietal characteristics, and nutritional properties of which are unknown. Furthermore, the varieties currently used in Chad were introduced a very long time ago, resulting in a deterioration in the nutritional quality of the seeds.

Furthermore, producers in West and Central Africa generally keep the seeds from their fields from one year to the next. This seed stock is highly exposed to various factors that can cause deterioration, as well as to economic conditions that may lead farmers to sell their seeds to meet urgent financial needs [7] without regard for the nutritional quality of the seeds. As a result, the population is forced to consume crops of poor nutritional quality.

Furthermore, if the producer does not have enough seeds at the time of sowing, he turns to a neighbor or the rural community and, in most cases, buys "run-of-the-mill" seeds that have been reclassified as being of low nutritional quality in order to meet his needs [7]. The population of Chad was estimated in 2007 at 10,238,807 inhabitants, with an annual growth rate of 3, 14%. About 87% of this population is poor, of which 80% live in rural areas and derive most of their income from agricultural activities.

Before the advent of oil, Chad's economy was primarily based on agriculture and livestock farming. Thus, while agriculture accounts for more than 74% of the population, it contributes only 22.7% (2005) to GDP (Gross Domestic Product), compared with 51.2% (2005) for industry and 26.1% (2005) for other services. This population is also faced with the problem of seeds with low nutritional value. Determining the physical and chemical characteristics of peanut and cowpea varieties rich in iron, zinc, and protein in Chad helps ensure that the population has a rich and varied diet.

The results of agronomic research on the four crops are available [8, 9, 10, 11, 12, 13,14]. Nevertheless, research should focus more on developing appropriate farming techniques [15] and introducing new varieties in order to increase crop yields in Chad.

*Corresponding Author: Touroumgaye GOALBAYE,

¹Université de Sarh BP 105 Sarh, Tchad.

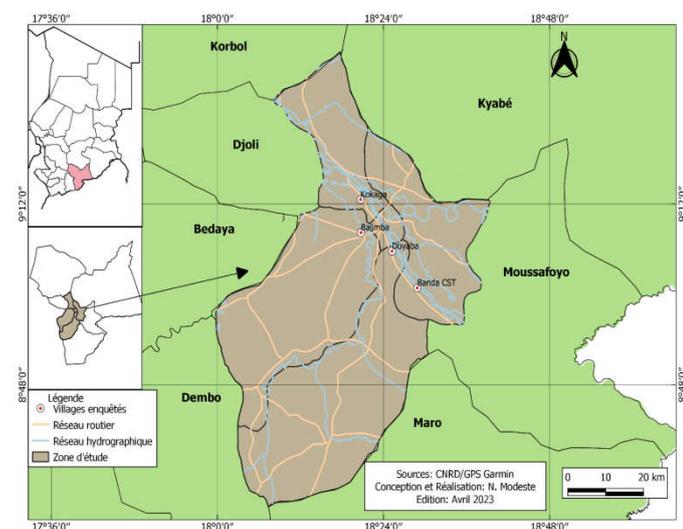
The study area covers the Barh Koh Department of Chad. In this area, the main activity of the population is agriculture. To this end, the main objective of this work is to contribute to improving the nutritional quality of the population. Specifically, the objective is to:

- Determine the physicochemical characteristics of local varieties of peanuts and cowpeas.
- Guide producers' choices towards the best nutrient-rich varieties.

MATERIAL AND METHODS

Study area

The study area covers the villages of Kemdéré and Maïbo in the Banda canton and the villages of Ngon bé gulaye and Maïbessé in the Balimba canton in the Barh Koh Department of Chad. In this area, the main activity of the population is agriculture.



Plant material

The plant material consists of the local Houdoum Kobé peanut variety and the local Moudjô nda cowpea variety, which are the most widely grown and consumed in Chad.

Methods

Samples of the local peanut variety houdoum kobé and the local cowpea variety Moudjô nda are collected from producers in the study area and analyzed in the laboratory to determine their physical and chemical parameters.

Physical and chemical analyses

All physicochemical analyses were conducted at the Food Quality Control Center Laboratory (CECOQDA) in N'Djamena (Chad). For each sample, various parameters were determined using methods based on international standards.

Sample collection

Local varieties of peanuts and cowpeas were collected for physicochemical analysis. These consisted of samples of Houdoum Kobé variety peanut seeds and Moudjô Nda variety cowpea seeds. All samples are collected from producers in villages within the study area. The samples were collected between September and October 2024.

Sample preparation

To determine the physicochemical characteristics of peanuts and cowpeas, five hundred (500) grams of samples of each variety were cleaned, packaged in sterile plastic bags, and stored in an insulated cooler at room temperature. They were then sent to the laboratory for various analyses. The analyses were conducted at the Department of Physicochemical Quality Control of Food, Water, and Beverages at the Food Quality Control Center (CECOQDA) in N'Djamena, Chad, in accordance with international standards (NF EN ISO).

Physical and chemical analyses

Evaluate the nutrient content of samples of local peanut and cowpea varieties (iron, zinc, protein, lipid, carbohydrate, and energy values contained in the seeds) using the non-destructive, dispersive energy X-ray fluorescence (EDXRF) spectroscopy method.

Data processing

The collected data are analyzed using SPSS (Statistical Package for Social Sciences version 20.0) software. The means of the different parameters are separated using the Student-Newman-Keuls (SNK) multiple comparison test.

RÉSULTATS ET DISCUSSION

Composition of the local variety of Houdoum Kobé peanuts in terms of iron, water, ash, and lipids

The iron content in peanut samples from producers in the villages of Kemdéré and Maïbo is 1.8 mg/100 g and 2.6 mg/100 g of seed. In contrast, in the villages of Maïbessé and Ngon bé gulaye, the iron content of the samples is 1.05 mg/100 g and 1.40 mg/100 g of seed (Table 1). These iron contents are below the limit value of 3.8 mg/100 g obtained in peanut seeds in Burkina Faso. The water content of peanut samples from the villages of Kemdéré and Maïbo is 7.05% and 8.15%. The peanut samples from Maïbessé and Ngon bé gulaye have water contents of 6.15% and 8.10%. These values comply with the maximum limit (9%) of CXS 154 – 1985. An author from West Africa obtained a high moisture content of 6% in peanuts [16]. However, these water contents in the study area are high compared to the water content of peanuts according to the Ciqual table of Anses – France, which is 2.2% [17]. The peanut samples from the villages of Kemdéré and Maïbo have ash contents of 2.15% and 2.35%. In contrast, the peanut samples from Maïbessé and Ngon bé gulaye have ash contents of 2.25% and 2.32%. These levels are similar to those in the West African food table. The lipid content of peanuts from the villages of Kemdéré and Maïbo is 42.15% and 44.05%. As for the villages of Maïbessé and Ngon bé gulaye, the lipid content of the samples from producers is 42.10% and 43.06%. These lipid contents in the study area are below those obtained by the authors in Burkina Faso [18], whose peanut lipid contents range from 45% to 49.9%. Furthermore, the Ciqual table from ANSES (French Agency for Food, Environmental and Occupational Health & Safety) gives a value of 49.1% and states that this content can reach 52% [17].

Table 1: Composition of the Houdoum Kobé peanut variety in F²⁺, H₂O, ash, and lipid

Villages	Sample code (mg/100g)	Iron	Water (%)	Ash (%)	Lipids (%)
Kemdéré	ARA0446	2,6	7,05	2,15	42,15
Maïbo	ARA0447	1,8	8,15	2,35	44,05
Maïbèssé	ARA02094	1,05	6,15	2,25	42,10
Ngonbégulaye	ARA02095	1,40	8,10	2,32	43,06

Composition of the local peanut variety houdoum kobé in terms of protein, carbohydrates, energy value, and zinc

The protein content of peanut samples from producers in the villages of Kemdéré and Maïbo is 25.40% and 25.32%, respectively, while those from producers in the villages of Maïbèssé and Ngon bé gulaye have protein contents of 25.25% and 26.15% (Table 2). These protein contents of peanut samples from the study area are close to the values obtained by the authors in Burkina Faso [18]. The carbohydrate content of peanut samples from producers in the villages of Kemdéré and Maïbo is 16.05% and 17.10%. Meanwhile, samples from producers in the villages of Maïbèssé and Ngon bégulaye have contents of 16.22% and 16.52%. The carbohydrate content of peanuts from the study area is low, but similar to the levels obtained by the author from West Africa [16]. The energy values of peanuts from producers in the villages of Kemdéré and Maïbo are 548.50 kcal/100g and 535.15 kcal/100g. Those from producers in the villages of Maïbèssé and Ngon bé gulaye are 542.65 kcal/100g and 545.45 kcal/100g. These energy values for the study area are lower than those obtained by another authors [19, 16] (580 kcal/100g) and (579 kcal/100g). According to the Ciqual table published by ANSES (French Agency for Food, Environmental and Occupational Health & Safety), peanuts are an energy-rich fruit providing 653 kcal/100g. The results of the physicochemical analysis revealed that peanut samples from producers in the villages of Kemdéré and Maïbo have zinc contents of 1.24 mg/100g and 1.46 mg/100g, while zinc contents of 1.05 mg/100g and 1.10 mg/100g were recorded in samples from producers in the villages of Maïbèssé and Ngonbé Gulaye.

Tableau 2 : Composition of the local peanut variety houdoum kobé in terms of protein, carbohydrates, energy value, and zinc

Villages	Sample code	Protein (%)	Carbohydrates (%)	Energy value (Kcal/100g)	Zinc (mg/100g)
Kemdéré	ARA0446	25,40	17,10	548,50	1,24
Maïbo	ARA0447	25,32	16,05	535,15	1,46
Maïbèssé	ARA02094	25,25	16,22	545,45	1,05
Ngon bé gulaye	ARA02095	26,15	16,52	542,65	1,10

Composition of the local variety Moudjô nda of cowpea in iron, water, ash, and lipids

The iron content of cowpea samples from producers in the villages of Kemdéré and Maïbo is 5.03 mg/100 g and 5.25 mg/100 g of seed. In contrast, in the villages of Maïbèssé and Ngon bé gulaye, the iron content of the samples is 5.13 mg/100 g and 6.05 mg/100 g of seed (Table 3). These iron contents are below the limit value of 7.6 mg/100 g obtained in cowpea seeds in Burkina Faso. The water content of the cowpea samples from the villages of Kemdéré and Maïbo is 8.15% and 9.20%. The cowpea samples from the villages of Maïbèssé and Ngon bé gulaye have water contents of 8.10% and 8.25%. These water contents in the samples from producers are below the limit value set by Codex Alimentarius 154-1985, which

requires a water content strictly below 15% for cowpea (Codex Alimentarius, 2007). These samples comply with the reference limit and are consistent with the work of several authors [20, 21, 22, 23]. The low moisture content found in cowpeas allows for good preservation of this legume. The cowpea samples from the villages of Kemdéré and Maïbo have ash contents of 3.05% and 3.15%. In contrast, the cowpea samples from Maïbèssé and Ngon bé gulaye have ash contents of 2.87% and 2.95%. These ash contents of cowpea comply with the standard recommended by the FAO, which varies from 2.0 to 4.3. It was obtained almost similar ash content for West African cowpea, namely 3.01% and 3.2% respectively [24]. The lipid content of cowpeas from the villages of Kemdéré and Maïbo is 1.05% and 1.15%. As for the villages of Maïbèssé and Ngon bé gulaye, the lipid content of the samples from producers is 0.90% and 1.02%. All these samples comply with the limit value from the Burkina Faso Food Composition Table (2005), where the limit values for cowpea lipids must not exceed 1.4%. The FAO gives lower values ranging from 0.2 to 3.2 with an average of 1.4%. Still in West Africa, the authors obtained 1.9% for cowpeas from Senegal and 1.73% for cowpeas from Burkina Faso, respectively [24, 18]. The West African Food Composition Table gave a lipid content of 1.24% [19].

Table 3: Composition of the local Moudjô nda cowpea variety in F²⁺, H₂O, ash, and lipid.

Villages	Sample code (mg/100g)	Iron	Water (%)	Ash (%)	Lipids (%)
Kemdéré	NIE0782	5,25	9,20	3,05	1,05
Maïbo	NIE0783	5,03	8,15	3,15	1,15
Maïbèssé	NIE02192	6,05	8,10	2,87	0,90
Ngonbégulaye	NIE02193	5,13	8,25	2,95	1,02

Composition of the moudjô nda variety of cowpea in terms of protein, carbohydrates, energy value, and zinc

The cowpea samples from producers in the villages of Kemdéré and Maïbo have protein contents of 21.15% and 22.05%. Those from producers in the villages of Maïbèssé and Ngon bé gulaye have protein contents of 21.20% and 22.15% (Table 4). These protein contents do not comply with the reference limit values from the Burkina Faso Food Composition Table (2005). According to this composition table, the protein content of cowpea must exceed 23.10%. Studies have reported values ranging from 20.37% to 25.28% for cowpea varieties in Ghana [25] and 22.55% for cowpea in Burkina Faso [18]. Cowpea samples from producers in the villages of Kemdéré and Maïbo have carbohydrate contents of 60.25% and 61.05%. In contrast, those from producers in the villages of Maïbèssé and Ngon bé gulaye have carbohydrate contents of 61.35% and 62.22%. The West African Food Composition Table gave a carbohydrate content of 62.6% for cowpea [19]. An author from Senegal obtained a carbohydrate content of 64.4% [24]. The FAO table gave a carbohydrate content of 61.4%. The energy values of cowpeas produced by farmers in the villages of Kemdéré and Maïbo are 320.90 kcal/100 g and 324.05 kcal/100 g, respectively. Those produced by farmers in the villages of Maïbèssé and Ngon bé gulaye are 320.48 kcal/100 g and 332.15 kcal/100 g, respectively. Cowpeas from the study area have a lower energy value than cowpeas from Senegal and Burkina Faso (341 kcal/100g), the FAO table (342 kcal/100g), and the West African food table (346 kcal/100g). The results of the physicochemical analysis revealed that the cowpea samples from producers in the villages of Kemdéré and Maïbo have zinc contents of 2.85 mg/100g and 2.92 mg/100g, while zinc levels of 2.96 mg/100g and 3.14 mg/100g were recorded in cowpea samples from producers in the villages of Maïbèssé and Ngonbé Gulaye.

These zinc levels are below the limit value of 3.8 mg/100g obtained in cowpea seeds in Burkina Faso.

Table 4: Composition of the moudjô nda variety of cowpea in terms of protein, carbohydrates, energy value, and zinc

Villages	Sample code	Protein (%)	Carbohydrates (%)	Energy value (Kcal/100g)	Zinc (mg/100g)
Kemdéré	NIE0782	22,05	60,25	320,90	2,85
Maïbo	NIE0783	21,15	61,05	324,05	2,92
Maïbéssé	NIE02192	21,20	62,22	320,48	3,14
Ngonbé gulaye	MAI01175	22,15	61,35	332,15	2,96

CONCLUSION

The objective of the study is to perform a physical and chemical analysis of samples of local peanut and cowpea seeds collected from producers. The results of the physical and chemical analysis showed that the iron, zinc, protein, lipid, carbohydrate, and energy content of these producers' seeds are below the limits or levels found in most West African countries. During our work, no certified or improved seeds were collected from producers for analysis. In Chad, certified or improved seeds are generally very expensive and unavailable. Therefore, it is because of the inaccessibility and unavailability of seeds that producers are forced to pay for poor-quality seeds (low specific and weight purity) at the market.

Looking ahead, improved or certified seeds should be promoted by setting affordable prices and raising awareness among producers to buy seeds from approved multipliers, otherwise all efforts will be in vain. When all producers are using certified seeds, it will be time to consider conducting new physical and chemical analyses to identify fortifying organic seeds.

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