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Biochemical Characterization of Peanuts and Cowpeas Consumed in the Sahelo-Saharan Zone of Chad

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Abstract

The seeds of two varieties of peanut (*Arachis hypogea L.*) and four varieties of cowpea (*Vigna unguiculata L.*) were collected in the Sahelo-Saharan zone of Chad. The biochemical composition of the seeds was evaluated to determine their nutritional value. The results showed variability among varieties. Thus, the moisture content of peanuts is between 3.50 and 4.71% and that of cowpeas is between 6.88% and 7.95%. The ash content is 2.57% for peanut varieties and varied from 4.14 to 4.95% for cowpea. The lipid content is between 46.72 and 48.36% in peanuts and between 0.81 and 1.45% in cowpeas. The protein content in peanuts varied from 26.3 to 27% and from 18.89 to 21.56% in cowpea. Concerning the carbohydrate contents, they were between 17.36 and 20.91% in peanuts, while it is located between 65.12 and 68.61% in cowpeas. The energy value of peanut varied between 609.32 and 612.68 Kcal/100 g. while the energy value of cowpea is much lower, between 355.70 and 361.43 Kcal/100g. The study revealed that peanut and cowpea seeds consumed in this area could be a good source of nutrients. Therefore, judicious exploitation of these seeds could provide a source of additional nutrients in the diet of the vulnerable population.

Keywords: Biochemical characterization; Arachis hypogea L; Vigna unguiculata L; nutritional value; Chad

Abbreviations: PDCAAS: Protein Digestibility Corrected Amino Acid Score; H: humidity Level; C: Ash Content; L: Lipid content; P: Protein; G: Carbohydrate Level

Introduction

Peanuts and cowpeas are legumes used as cash crops of great socio-economic and nutritional importance. The economical use of legumes makes them crops of choice to meet food security needs in developing countries [1]. Legumes have interesting nutritional and technological properties [2] and are sources of beneficial phytochemicals to combat free radicals [3]. The nutritional benefit of adding legumes to cereals has been the subject of numerous studies [4]. Chad is a low-income, landlocked country in the Sahel strip facing high levels of food insecurity and all forms of malnutrition. It is among the most vulnerable countries in the world in terms of climate change and is the second country most affected by food insecurity [5]. The country also faces real nutritional problems due, in part, to the poor use of available foods [6]. The diet of Sahelians, long considered solely or essentially cereal-based, is increasingly based on a range of other products which are becoming important locally and which are increasing in number [7]. In the Sahelo-Saharan zone, legumes constitute an important source of food and income for populations. This study focuses on the nutritional values of peanuts and cowpeas. The general objective is to evaluate the macronutrient content of peanut and cowpea varieties consumed in the Sahelo-Saharan zone of Chad.

Material and Methods

The study framework covers the Sahelo-Saharan zone of Chad. The plant material is composed of two (2) varieties of peanut *(Arachis hypogea L.)* and four (4) varieties of cowpea

(Vigna unguiculata L.). All varieties were obtained from randomly selected households in the study area. Legume variety samples were cleaned, packaged in sterile plastic bags then stored in an insulated cooler at room temperature then sent to the laboratory for various analyses. The analyzes were carried out at the physicochemical quality control department of Food, water, and beverages of the food quality control center (CECOQDA) in N'Djamena (Chad) according to international standards (NF EN ISO).

The humidity level (H) of the samples was determined by differential weighing of a 5g sample before and after passing it in an oven at 105°C for 2 hours by gravimetry or by standard NF EN ISO 712 or ISO 24557. The ash content (C), which designates the total mineral content of the product, was determined by differential weighing of a 5g sample after calcination in a muffle furnace at 550°C for 8 hours by gravimetry or according to the international standard (ISO 2171, 2010).

The Lipid content (L) of the samples was estimated by the ISO 11085 method.

For the estimation of protein (P) content, the ISO 20483 standard was used.

The carbohydrate level (G) was estimated by the different method of Egan et al.

The energy value per 100 g of the sample was determined by applying the Atwater and Benedict coefficients:

The Excel spreadsheet was used for calculations of means and standard deviations. Statistical analysis was performed with SPSS software (23.0).

Results

Nutritional composition of peanut

Figure 1 shows the nutritional composition of peanuts from the study area. The water content of the peanut is slightly higher in VAR A1 with 4.71% while it is 3.5% in VAR A2. Both varieties of peanut have the same ash content of 2.57. The lipid content of peanut is 46.72 and 48.36% respectively in VAR A2 and VAR A1. The protein content is almost identical with 27% in VAR A1 and 26.3% in VAR A2. The carbohydrate level of the VAR A1 peanut is 17.36%. This rate is lower than that of VAR A2 which is 20.91%.

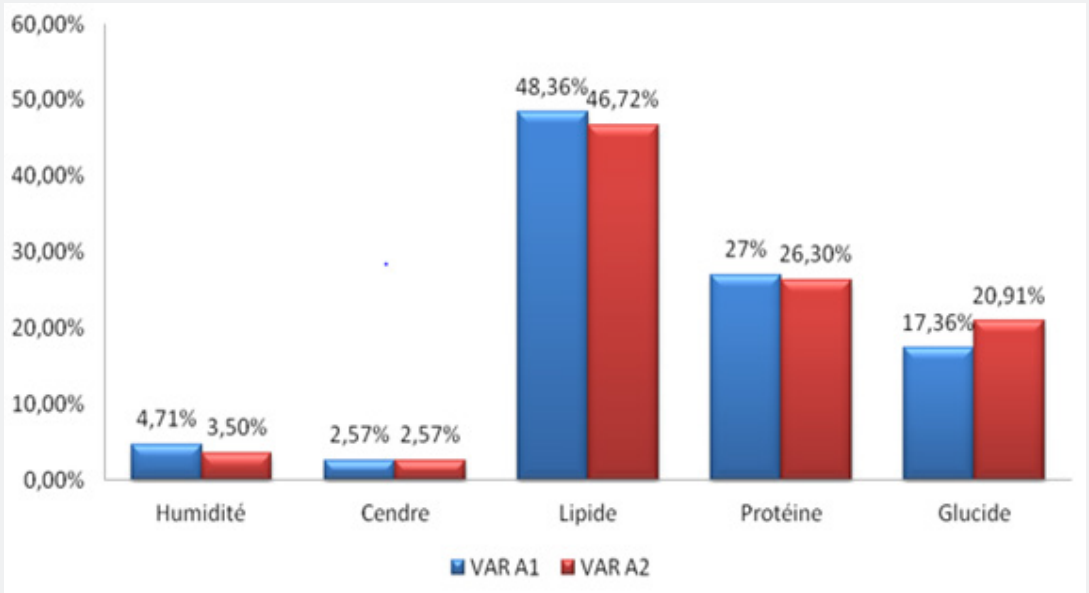

Figure 1: Nutritional composition of peanuts

Nutritional composition of cowpea

Table 1 gives the nutritional composition of the cowpea varieties analyzed. It shows that the cowpea in the study area has a water content between 6.88% (VAR N3) and 7.95% (VAR N2). The ash content of the varieties studied varies from 4.14 to 4.95%. VAR N1, VAR N2 and VAR N3 have almost the same ash rate. Compared to peanuts, cowpeas have a low lipid content of between 0.81 and 1.45%. The varieties VAR N1 and VAR N3 presented the same lipid content. The protein content of cowpea is much higher than that of peanuts and is between 18.89 and 21.56%. The carbohydrate content of cowpea is greater than 60%. It is between 65.12 and 68.61%. VAR N2 and VAR N3 have almost the same sugar level.

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Table 1: Nutritional composition of cowpea varieties

Sample Code	Water (%)	Ash (%)	Lipid (%)	Protein (%)	Carbohydrate (%)
VAR N1	7.23	4.15	1.11	18.89	68.61
VAR N2	7.95	4.14	0.81	19.41	67.68
VAR N3	6.88	4.16	1.11	20.68	67.16
VAR N4	6.91	4.95	1.45	21.56	65.12

Nutritional value of peanut and cowpea

Analysis of the results in Table 2 shows that peanut has an energy value of 609.32 and 612.68 kcal/100g while the energy value of cowpea is much lower, between 355.70 and 361.43 Kcal/100g.

Table 2: Calorific value of peanut and cowpea varieties

Type of legume	Sample Code	Energetic value (Kcal/100g)
Peanut (n=2)	VAR A1	612.68
	VAR A2	609.32
Cowpea (n=4)	VAR N1	360.07
	VAR N2	355.7
	VAR N3	361.43
	VAR N4	359.84

Discussion

Peanut moisture content values are consistent with the maximum limit (9%) of CXS 200 – 1995. [8] obtained a high moisture content of 6%. According to the Ciqual table from Anses - France, peanuts have a water content of 2.2% [9]. The peanut varieties analyzed have the same ash content. This rate is like those of the West African food table. Concerning the lipid content of peanut in this study, [8,10,11] obtained similar results in the range of 49.9%, 45% and 46.72% respectively. The Anses – France Ciqual table gives a value of 49.1% and that this content can reach 52% [9]. Protein contents of peanut are like those of [8,10,11]. According to Protein Digestibility Corrected Amino Acid Score (PDCAAS), peanut protein is nutritionally equivalent to meat and eggs for human growth and health [12]. Just like other legumes, peanuts are rich in protein but low in carbohydrates. In fact, the carbohydrate content of peanuts is between 17.36 and 20.91%. These rates are like the rates obtained by [8,10]. The energy values of the peanut samples in this study are higher than those obtained by [10] (580 kcal/100g) and [8] (579 kcal/100g). According to the Ciqual table from Anses – France, peanuts are an energetic fruit providing 653 kcal/100g.

The analysis of the results of the water content of cowpea showed that all the samples have a level strictly lower than 15% and therefore comply with the reference limit value required by the codex Alimentarius for cowpea [13]. These results agree with the work of [14-17]. The low humidity levels found in cowpeas allow for good conservation of this legume. Three (3) cowpea varieties meet the standard recommended by the FAO, i.e., 3.3 (2.0 to 4.3). One variety (VAR N4) does not comply with this standard. According to USDA Food Data, the total ash content of cowpeas is 3.4g/100g. [10,18] obtained an almost similar ash rate for West African cowpea, i.e., 3.01 and 3.2% respectively. Concerning the lipid content of cowpea seeds, according to the Food Composition Table of Burkina Faso (2005), the limit values must exceed 1.4%. The FAO gives reference values ranging from 0.2 to 3.2 with an average of 1.4%. [18,11] obtained respectively 1.9% for cowpea from Senegal and 1.73% for cowpea from Burkina Faso. There Table of composition of West African foods gave a lipid content of 1.24% [10].

All cowpea varieties showed low protein content. These protein contents do not comply with the reference limit values from the Food Composition Table of Burkina Faso (2005). Indeed, according to this composition table, the protein content of cowpea must exceed 23.10%. Studies have reported values of 20.37% to 25.28%, on cowpea varieties in Ghana [2], 22.55% on cowpea from Burkina Faso [11]. According to [19], they are a good source of protein, with values ranging from 20.3 to 39.4 g/100g. The carbohydrate level of cowpea is between 65.12 and 68.61%. The Table of composition of West African foods from [10] gave carbohydrate rate of 62.6% for cowpea. [18] obtained a carbohydrate rate of 64.4% in Senegal. The FAO table gave a carbohydrate rate of 61.4%. The energy value of cowpea is between 355.70 and 361.43 Kcal/100g. VAR N3 cowpea has a somewhat high energy value. Cowpea from the study area has a higher energy value compared to cowpea from Senegal (341 Kcal/100g), the FAO table (342 Kcal/100g) and the West African food table (346 Kcal/100g).

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Conclusion

The valorization of local products requires good knowledge of the quality characteristics of raw materials. This study highlights the physicochemical and nutritional quality of peanuts and cowpeas from the Sahelo-Saharan zone of Chad. Biochemical analysis gives on the one hand, the nutritional profile of each variety of legume studied and thus offers consumers the opportunity to choose them about use. On the other hand, it can be used to evaluate nutritional intakes in the case of food consumption studies. Thus, this study shows that legumes are essentially energy-rich foods with high carbohydrate contents. Peanuts, which contain much more lipids, generally constitute a very good complement to a cereal-based diet, very rich in carbohydrates. Legumes have a high protein content, so they can be, at lack of foods of animal origin, essential supplements in cereal-based rations, especially in the study area where the diet is mainly cereal-based.

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