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# Research Article
# Determination of the Nutritional Value of *Acacia macrostachya* (Reichend.ex DC) and *Cirina butyrospermi* (Vuillet) Used in Local Chicken Feeding in Burkina Faso

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## Abstract

**Background and Objective:** In Burkina Faso, poultry producers are suffering from the rising feed costs, especially for protein sources such as fishmeal, groundnut cake and soybean meal. The present study aimed to determine the nutritional value of *Cirina butyrospermi* and *Acacia macrostachya* seeds as an alternative feed ingredient for local chickens. **Materials and methods:** The dry matter, humidity, crude protein, nitrogen, neutral detergent fiber (NDF), acid detergent fiber (ADF), lipids, energy and minerals of *Cirina butyrospermi* and *Acacia macrostachya* seeds were determined. The ash contents and fatty acids profile was investigated. **Results:** This study revealed that *Cirina butyrospermi* (50.2% dry basis) and *Acacia macrostachya* seeds (40.3% dry basis) were high in protein. Concentrations of NDF (32.8±8.35 and 19.7±0.17) and ADF (29.4±1.57 and 18.8±5.05) were found in *Cirina butyrospermi* and *Acacia macrostachya* samples, respectively. Palmitic, Stearic, Linoleic, Oleic and α-Linolenic acids were the most abundant fatty acids in the two plant samples. Both samples contain some minerals (calcium, potassium, magnesium, zinc) and are rich in energy. **Conclusion:** Due to their potent source of protein, *Cirina butyrospermi* and *Acacia macrostachya* could be an alternative feed ingredient to reduce the high cost of fishmeal in the local chickens farming system.

Key words: Acacia macrostachya seed, Burkina Faso, *Cirina butyrospermi*, local chickens, nutritional values

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Burkina Faso is a country with an agro-sylvo-pastoral vocation. The breeding activity occupies a predominant economic position and is practiced by more than 80% of households who derive all or part of their income from it[1]. Poultry farming plays an important role in the livelihoods of people in rural areas where poultry are raised not only for local consumption, ritual and customary practices but also for religious and social practices[2]. Despite this socio-economic importance, poultry farming experiences many constraints that limit its development, including feed which represents 60 to 80% of production costs[3,4]. These include fish meal, which accounts for 25% of production costs[5]. This meal is used in avian feed as an important source of protein[6] but its high cost is a brake on the development of poultry activity in several countries, particularly in Burkina Faso[4]. The current challenge would be to develop local resources, which will play the role of protein source but which will be both less expensive and within the reach of poultry farmers. Several studies have shown that in addition to animals, certain plants are important sources of protein, these are the leaves of *Moringa oleifera*, *Leucaena leucocephala* and many others[7]. Seeds of *Acacia macrostachya* are mainly used by the local population as a source of protein, during major customary and religious ceremonies indicating their cultural attachment[8,9], it is the same for *Cirina butyrospermi* which is a caterpillar from *Vitellaria paradoxa*. This caterpillar is also eaten by the Burkinabé population for protein intake[10]. Despite the widespread uses of *Acacia macrostachya* (seeds) and *Cirina butyrospermi* in Burkina Faso as a source of protein by the population[11] little is known about their feeding value for the local chickens. This study was therefore, undertaken to characterize the nutritional value of *Acacia macrostachya* (seeds) and *Cirina butyrospermi* as feed ingredient in local chicken farming in Burkina Faso.

## MATERIALS AND METHODS

**Laboratory analysis:** The seeds of *Acacia macrostachya* and Cirina butyrospermi were collected from Nasso located at 15 km from Bobo-Dioulasso (Burkina Faso) in June 2019. The samples were crushed after sun dried and stored for various analysis. The dry matters and ash was determined using the official methods of analysis[12]. The crude fat was extracted with the anhydrous diethyl ether using the Soxtec™ 2050 apparatus[13]. The crude proteins and nitrogen were determined with the Kjeldahl method using the digestion block and the Foss 8400 system[14]. Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) were analyzed using the Ankom 2000 Fiber Analyzer. The gross energy was measured with Parr 6300 Calorimeter. For that, solid pellets were made and introduced into the calorimeter to determine the energy value. Energy of each sample was calculated directly in relation to its weight. The ash was mixed with 5 mL of concentrated $HNO_3$ and 12.5 mL of 50% HCl. The mixture was boiled at a low temperature on a hot plate and then allowed to cool. After cooling, the samples were filtered into and calibrated to 100 mL using distilled water. The different mineral salts were determined by atomic absorption or by spectrophotometer for phosphorus[15]. Finally, the fatty acids profile was determined by the direct methylation method as described by Sukhija and Palmquist[16] with some modifications.

**Statistical analysis:** The results were expressed as an average±standard deviation (SD). Statistical analysis was performed (calculation of means, standard deviations and p-values) using a data processing software package CSPro.

## RESULTS

**Nutritional value:** Table 1 shows the nutritional contents of *C. butyrospermi* and *A. macrostachya* seeds. The nutrient levels were significantly higher in *C. butyrospermi* samples ($p<0.001$) than *A. macrostachya*. protein contents in *C. butyrospermi* (50.2±2.66%) were higher than *A. macrostachya* (40.3±0.74%). The same trend was found with nitrogen, fibers and energy. It was observed that *C. butyrospermi* contain twice as much fats as *A. macrostachya*. Both samples contain some minerals, however, the calcium content was higher ($p<0.001$) in *Acacia macrostachya* seeds (0.41%) than that of *Cirina butyrospermi* (0.28%).

**Fatty acid content:** The fatty acids contents of *Cirina butyrospermi* and *Acacia macrostachya* seeds were ranged from 0.04-34.20% (Table 2). About the nineteen fatty acids quantified there are eight saturated, three omega-3, three omega-6, one omega-7, two omega-9 and two omega-11. Among the two plant samples, palmitic and Stearic acids were the most abundant saturated fatty acids. Concerning the serial of omega, *Acacia macrostachya* seeds contain a high amount of linoleic acid (32.49%) and Oleic acid (34.20%) whereas, *Cirina butyrospermi* seeds contain a high amount of α-Linolenic acid (31.24%).

Table 1: Nutritional contents of *Cirina butyrospermi* and *Acacia macrostachya* seeds

| Nutrients | *Acacia macrostachya* seeds | *Cirina butyrospermi* | p-value |
|---|---|---|---|
| Dry matter | 90.70±0.05% | 90.62±0.69% | 0.7620 |
| Ashes | 4.25±0.05% | 5.82±0.61% | 0.0004 |
| Humidity | 9.30±0.05% | 8.34±0.69% | 0.7620 |
| Protein | 40.30±0.74% | 50.20±2.66% | 0.0004 |
| Nitrogen | 6.45±0.12% | 9.20±0.43% | 0.0004 |
| Lipids | 10.90±0.13% | 27.00±6.45% | 0.0006 |
| NDF | 19.70±0.17% | 32.80±8.35% | 0.0005 |
| ADF | 18.80±5.05% | 29.40±1.57% | 0.0004 |
| Energy | 5021.00±14.62 kcal | 6008.00±115.68 kcal | 0.0008 |
| Potassium | 1.43±0.03% | 2.10±0.25% | 0.0002 |
| Iron | 0.10±0.00% | 0.13±0.03% | 0.0051 |
| Phosphorus | 0.01±0.00% | 0.05±0.01% | 0.0009 |
| Zinc | 0.58±0.03% | 1.13±0.06% | 0.0001 |
| Magnesium | 0.24±0.01% | 0.21±0.10% | 0.9540 |
| Calcium | 0.41±0.00% | 0.28±0.11% | 0.0003 |

Comparison between the Nutrients content of *Acacia macrostachya* and *Cirina butyrospermi* seeds, Values were Mean±standard deviation (n = 2), $p<0.001$

Table 2: Fatty acid contents of *Cirina butyrospermi* and *Acacia macrostachya* seeds

| Classification | Symbol | Name of compounds | *Acacia macrostachya* (%) | *Cirina butyrospermi* (%) |
|---|---|---|---|---|
| Saturated fatty acids | C14:0 | Myristic acid | 0.13 | 0.51 |
| | C15:0 | Pentadécanoïc acid | 0.11 | 0.28 |
| | C16:0 | Palmitic acid | 15.42 | 16.26 |
| | C17:0 | Margaric acid | 0.17 | 1.48 |
| | C18:0 | Stearic acid | 10.99 | 30.54 |
| | C20:0 | Arachidic acid | 1.71 | 0.37 |
| | C22:0 | Docosanoïc acid | 1.35 | 0.15 |
| | C24:0 | Tétracosanoïc acid | 1.22 | 0.04 |
| Omega-3 | C18:3n3 | α-Linolenic acid | 0.19 | 31.24 |
| | C20:3n3 | *cis*-11,14,17-Eicosatrienoic acid | 0.00 | 0.29 |
| | C22:6n3 | Docosahexaenoic acid | 0.08 | 0.11 |
| Omega-6 | C18:2n6 | Linoleic acid | 32.49 | 5.16 |
| | C18:3n6 | γ-Linolenic acid | 0.07 | 0.36 |
| | C22:2n6 | Docosadienoic acid | 0.12 | 0.14 |
| Omega-7 | C16:1n7 | Palmitoleic acid | 0.29 | 0.49 |
| Omega-9 | C18:1n9 | Oleic acid | 34.20 | 11.92 |
| | C22:1n9 | Erucic acid | 0.23 | 0.00 |
| Omega-11 | C18:1n11 | Vaccenic acid | 0.91 | 0.49 |
| | C20:1n11 | Gadoleic acid | 0.31 | 0.18 |

## DISCUSSIONS

Feed formulation for animal especially local chickens require knowledge of the composition and nutritional value of the ingredients used. For this reason, the nutrients including proteins, mineral salts, lipids, dietary fibers (NDF and ADF), ash, dry matter, moisture content and energy value of *Cirina butyrospermi* and the seeds of *Acacia macrostachya* were determined in this study. After analysis it was observed that both samples contained some impressive levels of each nutrient tested. *Cirina butyrospermi* and *Acacia macrostachya* seeds were very high in protein. Indeed, proteins are macromolecules made up of twenty amino acids (AA), 11 of which are essential. Essential amino acids cannot be synthesized by animals, especially chickens, therefore, they must be provided by food in an amount that meets requirements[17]. Protein is also involved in building muscle, feathers, eggs and cell regeneration in chickens. In addition to proteins, these two species contained very high levels of lipids which are also macromolecules composed of several types of fatty acids, including mainly the saturated fatty acids (Palmitic acid and Stearic acid) and the serial of omega such as omega-3 (α-Linolenic acid), omega-6 (Linoleic acid) and omega-9 (Oleic acid). These fatty acids cannot be synthesized in the

chicken's body but are necessary for normal growth and the physiological functions of cells[18]. *Cirina butyrospermi* and *Acacia macrostachya* seeds had acceptable levels of metabolizable energy, which is necessary for maintenance, growth or egg production. They are also rich in crude fibers (ADF and NDF). Previous studies have shown that an increased crude fiber content has a positive impact on feather pecking (cannibalism) and on the shape of eggs[19]. *Cirina butyrospermi* and *Acacia macrostachya* seeds are also rich in mineral trace elements (iron and zinc) which are involved in anemia and depigmentation of the feathers, growth, immunity, resistance to disease and blood egg-laying in breeding females. *Cirina butyrospermi* and the *Acacia macrostachya* seeds contain macro-minerals (calcium, phosphorus, magnesium, potassium) that are essential for the constitution of the skeleton[20]. In short, *Cirina butyrospermi* and *Acacia macrostachya* seeds may be the solution to the high cost of fishmeal in the poultry. They are very rich in nutrients necessary for chicken growth, especially in protein compared to many other plants or animals considered as sources of protein (12-30% for *Cassia tora*, 28.01% for *Leucaena leucocephala* )[21]. In addition, their protein content (50.23% for *Cirina butyrospermi* and 40.3% for *Acacia macrostachya* seeds) was close to that of fish meal, which is 63%[6,22]. The same was true for the content of other nutrients (mineral salts, lipids, energy and dietary fiber) which were close to those of fish meal. As a result of these different considerations and their low-cost accessibility, *Cirina butyrospermi* and *Acacia macrostachya* seeds could be incorporated into the diet of local chickens as a source of protein. Thus, these species could be an alternative solution to the high cost of fishmeal in the poultry sector.

## CONCLUSION

*Cirina butyrospermi* and *Acacia macrostachya* seeds had high levels of crude protein, nitrogen, minerals, lipids, fatty acids, energy and crude fiber. The nutritional composition of *Cirina butyrospermi* and *Acacia macrostachya* seeds are very useful for the formulation of local chickens feed in Burkina Faso.

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