

# Perception of *Lagénaria siceraria* Fruits on Their Nutritive, Therapeutic and Organoleptic Values

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**Abstract:** *L. siceraria* or commonly called calabash, or gourd, is an annual herbaceous plant of the family Cucurbitaceae, cultivated as a vegetable for its fruit, calabash, sometimes eaten fresh as a vegetable or more often used in the dry state to make various tools. This work was done in order to know the nutritional and therapeutic values of the calabash in the in three urban communes of Niger, then on the sensory evaluation and chemical analysis of reducing sugar. These analyzes were performed on four different calabash varieties, which revealed significant values ranging from 9.18% to 12.77% reducing sugar. The local varieties known as of *Kwarya*, *Louday*, *Tsanaa*, *Gaindama*, were evaluated by their organoleptic properties where the *Gaindama* recorded the highest value followed by *Louday* on the general acceptability. According to this study, more than 90% of the population surveyed know calabash because of their nutritional and therapeutic values, and is also used in the art or as a kitchen utensils. However, this plant rich in water, calorie and protein, contributes as well in several treatments of diseases: diabetes, jaundice, chicken pox etc. Thus, the calabash is often recommended by dieticians.

**Keywords:** Nutrition, Calabash, Reducing Sugar, Therapeutic, Sensory Evaluation

## 1. Introduction

The calabash plant (*Lagenaria siceraria*) is a large tropical plant, from two different families of Bignoniaceae and Cucurbitaceae. Commonly called gourd (in English) and improperly calabash. However, the fruit has been known since ancient times in Africa and around the Mediterranean. Some long varieties are eaten very young. The pericarp of the fruit dries and matures at maturity and becomes hard as wood, the dry fruit is then used as a tool or container [1, 2].

*L. siceraria* comprises 6 species, including 5 in the wild in Africa. These wild species are perennial and their bitter fruits, spherical to ellipsoids, of small size, give a glutinous juice rich in saponins. The cultivated species *L. siceraria* is

polymorphic and has many local varieties; its phenotypic variation is continuous and difficult to quantify. The hard and thick skin of the fruit, as well as the well-formed "handle", are often their characteristics [3]. The local edible types are small and rounded, some communities, wart fruits are chosen for consumption. Fruit shape variation is greater than that of seed, and there is no correlation between fruit shape and seed shape [4]. The *L. siceraria* species has a large morphological diversity, meaning that the multiplicity of their usages [5, 6]. Generally, in the Sahel region four types of *L. siceraria* varieties are found names in Hausa *Gaindama*, *Kwarya*, *Louday* and *Tsana* (Figure 1).

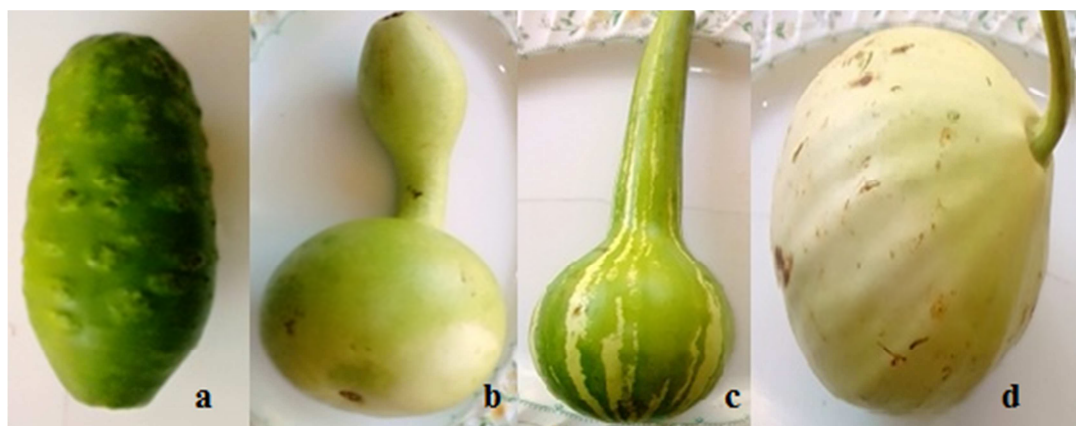


Figure 1. The varieties of *Lagenaria siceraria* (Tsana, Gaidama, Louday and Kwarya).

The nutritional composition of the immature fruits of the calabash was widely studied by Leung et al. [7]. Its oil is rich in linoleic acid (about 60%), but contains only 0.1% linolenic acid. In bitter fruits, one of the main components of bitterness is cucurbitacin B, which is toxic. Elaterase, an active  $\beta$  glucosidase, was isolated from bitter fruit juice; it is an enzyme used for the hydrolysis of the bitter principles of Cucurbitaceae, capable of separating glucose from triglucosides and tetraglucosides. Modern pharmacological studies have shown that fruit of calabash possesses various positive effects in preventing various conditions including pain and inflammation, has diuretic activities, and is also effective in hyperlipidemic condition, cardiotoxicity and stress [8, 9]. Literature showed that the anti-inflammatory, antihepatotoxic and antiatherosclerotic actions are associated with the radical scavenging activities of the active constituents of the vegetables and fruits rich sources of antioxidants, such as vitamin A, vitamin C, vitamin E, carotenoids, polyphenolic compounds and flavonoids, which prevent free radical damage, reducing risk of chronic diseases [10, 11].

Consumers demanding for natural healthy food products and opportunity to rediscover this nutritious fruits as functional foods. Therefore, this work is aimed to evaluate the perception of nutritive and therapeutic values of *L. siceraria* by the population surveyed. Furthermore, analysis of sensory evaluation and determination of reducing sugar of its fruits were carried out.

## 2. Materials and Methods

### 2.1. Materials

The fruits of *L. siceraria* were procured in the month of August to September from the local market of Jiratawa/Maradi and its botanical identity was confirmed by

the Crops Production Sciences and Technology Department of Dan Dicko Dankoulodo University of Maradi, Niger.

### 2.2. Methods

#### 2.2.1. Population and Survey Procedure

The survey involved all segments of the population (young, adult, and elderly) who consume the calabash fruits varieties and use it for their various activities. The survey took place in three urban communes of Niger (Maradi, Niamey and Zinder) from June 1 to August 30, 2016 using a questionnaire to interview people for survey.

#### 2.2.2. Sensory Evaluation

Sensory analyses of *L. siceraria* fruit samples were carried out 30 minutes to 1 hour after boiling it by the panelists composed of students and staff from food science major, Dan Dicko Dankoulodo University, Maradi, Niger in addition with some invited persons. The freshly boiled *L. siceraria* fruits were submitted for an acceptance test, applying a hedonic scale of 5 point [12]. The following sensory attributes were evaluated: sweetness, colour, texture, flavour and overall acceptability. Products were rated from 0 to 5 (0 means dislike and 5 means like very much).

#### 2.2.3. Reducing Sugar

One gram of sample was diluted (vortex) in 100 mL of distilled water and 1 mL of the solution was taken and mixed with 1 mL of distilled water plus 1.5 mL of Dinitrosalicylic Acid (DNS) then heated for 5 min in boiling water. The mixture was cooled off to room temperature, topped up to 25 mL and its absorbance was then measured at 520 nm [13]. The reducing sugar was calculated using D-glucose as standard:  $Y = 0.4173x - 0.0168$ ;  $R^2 = 0.9935$

Where: Y = Absorbance (spectrophotometer reading); X = Concentration of reducing sugar.

$$[\text{Concentration from equation (1)} \times \text{Volume (100 mL)}] \div [\text{sample weight (1 gram)}]$$

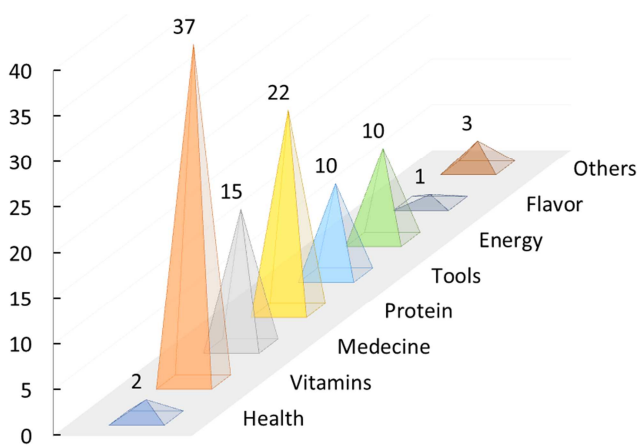
#### 2.2.4. Statistical Analysis

Statistical analysis of data was performed using IBM-SPSS Inc. software (version 20.0). One-way analysis of

variance (ANOVA) was used to determine significant differences between means, with the significance level taken at ( $p < 0.05$ ). Duncan test was used to perform multiple comparisons between means.

### 3. Results

According to this study more than 90% of the surveyed population in this region knew about calabash and up to 89% use it in their household activities or consume it in case of need. It was found that 52% of this population knew the different varieties of *L. siceraria* especially *Tsana* with a percentage of 48.15%, *Kwarya* 15.74%, *Chantou* 12.96% to name just that. Moreover, raining season is the period during which over 90% of the population surveyed said to more take advantage of the varieties of *L. siceraria* for consumption and use as a container and utensil. Indeed only 2% of people grow this plant outside the raining season. In addition, 81% of the population surveyed knew the nutritional values of calabash and even mentioned some values such as vitamins (37%); protein (22%); medicine (15%); energy (10%) (Figure 2).



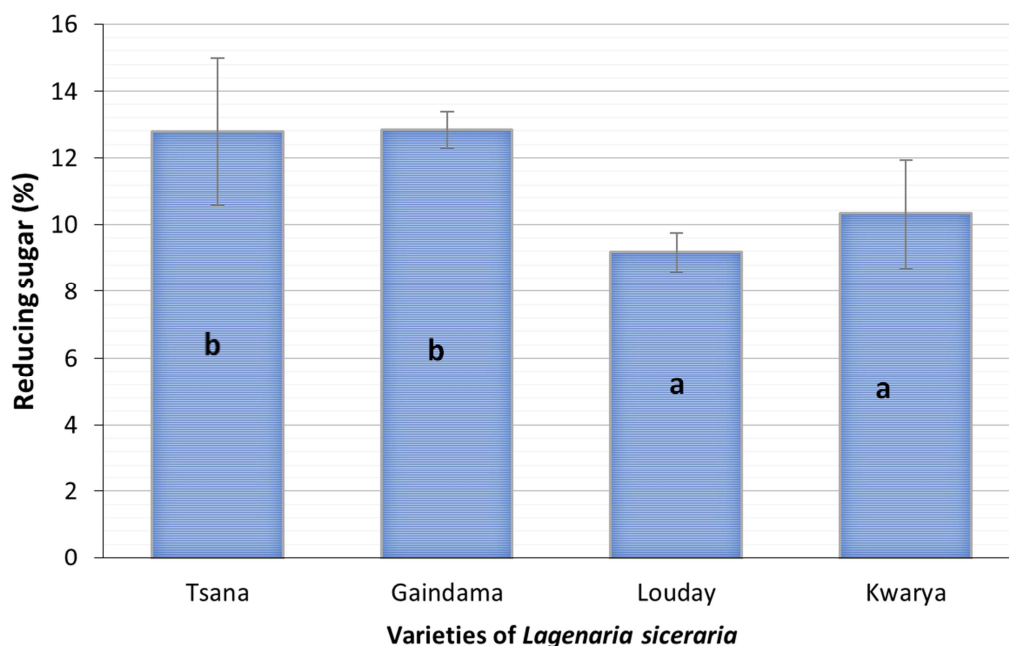
**Figure 2.** Distribution of the population surveyed according to their knowledge on the different nutritional and therapeutic values of Calabash varieties.

Table 1 present the sensory evaluation of four varieties of *Lagenaria siceraria*, in this study through the panels revealed that the color after cooking turn to be the same with no significant differences within the samples values ( $P < 0.05$ ). As far as sweetness is concerned, it was found that the variety of *Louday* and *Tsana* have almost the same values though when compare with *Gaindama* and *Kwarya* significant variation were observed ( $P < 0.05$ ), that is to say, the higher value comes with *Gaindama* then that of *Kwarya* both lower than the two counterparts. These varieties of calabash tasted with the same flavor for the *Louday*, *Gaindama* and *Tsana*, significantly ( $P < 0.05$ ) greater than *Kwarya*. However, the panelists expressed closely the same sensation of texture for the whole four varieties despite the pimple skin of *Tsana* variety that character seemed to become smooth after boiling it.

**Table 1.** Sensory evaluation of four varieties of *Lagenaria siceraria*.

|                        | Tsana                  | Gaindama               | Louday                 | Kwarya                 |
|------------------------|------------------------|------------------------|------------------------|------------------------|
| Couleur                | 2.98±0.25 <sup>a</sup> | 3.18±0.28 <sup>a</sup> | 3.35±0.48 <sup>a</sup> | 2.68±0.98 <sup>a</sup> |
| Sucré                  | 2.70±0.40 <sup>c</sup> | 1.98±0.08 <sup>b</sup> | 3.03±0.50 <sup>c</sup> | 1.03±0.03 <sup>a</sup> |
| Flaveur                | 2.83±0.31 <sup>b</sup> | 2.83±0.68 <sup>b</sup> | 2.78±0.33 <sup>b</sup> | 1.08±0.06 <sup>a</sup> |
| Texture                | 2.52±0.08 <sup>a</sup> | 3.30±0.73 <sup>a</sup> | 3.25±0.43 <sup>a</sup> | 2.13±0.94 <sup>a</sup> |
| Acceptabilité générale | 3.38±0.16 <sup>b</sup> | 3.67±0.76 <sup>b</sup> | 3.57±0.31 <sup>b</sup> | 1.17±0.10 <sup>a</sup> |

It can be seen from Figure 3 that the *Tsana* and *Gaindama* varieties are significantly ( $P < 0.05$ ) the same in the composition of reducing sugar, similarly like *Louday* and *Kwarya*. However, the two side are statistically different ( $P < 0.05$ ). In this case the calabash varieties analyzed in this study ranged from 9.18% (*Louday*) to 12.77% for *Tsana* with significant differences ( $P < 0.05$ ) between (*Louday* and *Kwarya*) and (*Tsana* and *Louday*).



**Figure 3.** Reducing sugar composition of four varieties of *Lagenaria siceraria*.

## 4. Discussion

The calabash is a plant recognized by the Sahel region population in general and particularly the population of the three urban communes of Niger (Maradi, Zinder, and Niamey) where the survey was carried out. However, the study shows that women were more interested in calabash cultivation than the men, which corroborates with the findings of Zougmore et al. [14] who explained that in coastal countries women are the only ones who cultivate calabash varieties on a small scale. Despite its high nutrient content, calabash cultivation remain very low in this part of the world compared to cereals or other pulses. Unlike, in some area in Sahel region this practice are getting better and better according to the study by Ouattara [15]. In terms of consumption and usage of calabash varieties, this study suggested significant distinction of gender and age among consumers, and the majority were young people aged of 18-30 years according this survey. For instance, in India the processing into foods of the calabash is limited to the juice as a drink for its known health benefits. Unlike in Pakistan, the fresh calabash is used to prepare an appetizing sweet dish called *aukikihalwa*. Indeed, studies have shown that in Africa, where it is thought to have been originated, the calabash is also used in stews of meat, poultry and seafood [14, 16, 17]. Moreover in the Sahel, precisely in Niger this survey noticed out that calabash diversified utility such as making peanut butter calabash recipe, as a legume for stew making and some time as dessert by just boiling the fresh young fruits.

The calabash varieties are cultivated for wide use depending on its shape as well, the *Louday* variety which is mostly used in the Sahel as a drinking or liquid holding tool, *Kwarya* could be big or small depending on its varieties which serves as a container with which one can put or carry many things [2]. Another usage of the calabash is to make tools when the fruits are matured and dried; in addition, other people make musical instruments or decorative art. Calabash fruit's nutritional and therapeutic values recognized by the surveyed population gave it a place of choice, they can even make distinctions between different varieties such as *Gaindama* and *Kwarya*, *Louday*, *Tsana*, *Shantu* just to name that. A positive point revealed by this survey is the knowledge of the nutritional and therapeutic values of calabash by the sampled population, 81% of them recognized to have an idea about *L. siceraria* varieties, they confirmed that the plant is very rich in water, protein, vitamins and energy. These results corroborate with a study conducted by Darekar et al. [18] retracing the nutritional composition of the calabash. Moreover, it was thought that calabash leaves and fruits are used to treat gastric ulcer or constipation due to food poisoning, in addition, the calabash can also be used to cure jaundice [4, 17].

Research have reported the numerous nutritional benefit of the calabash for mankind [8, 19]. Based on these results the varieties of *L. cisseraria* can be regarded as a source of nutrients such as proteins, energy and sometime as disease

relief. Furthermore, calabash intervened as utensils in various family daily activities, it is a mean for rehydration due to high content in water. In fact it has said to contribute in diabetes treatment [19]. The general knowledge of the populations where these plants are grown could be a factor to elevate the nutritional status and food security in the region; thus, Ihekoronye and Ngoddy [20] mentioned in their book that the fruits of calabash are important source of vegetable protein, fat, carbohydrate and calcium. The color of the studied calabash varieties of the *L. siceraria* (*Tsana*, *Gaindama*, *Louday* and *Kwarya*) (Figure 1) shows to be from whitish to greenish color before cooking, then after boiling it turned towards dark green for all the samples which were also used for sensory evaluation. Despite the similarities in the color regardless of others organoleptic properties, the overall acceptability seemed to be that the variety of *Tsana*, *Gaindama* and *Louday* were more appreciated and accepted significantly ( $P < 0.05$ ) by the panelists.

This study helped to understand the importance of reducing sugar in nutrition. Carbohydrates are sugars and related substances (starch, fiber, etc.); they are the major constituents of the most consumed foods (vegetables, cereals), the main source of energy in the diet because they are the easiest and the cheapest to produce. There is a direct relationship between standard of living and the share of carbohydrates in total energy intake in living beings; this is how cells need sugar permanently, or more precisely glucose. Glucose is the fuel of cells, the body must therefore provide glucose to cells throughout the day either by the conversion of the reserve or by factory from starches, lipids and proteins. This is the purpose of food, digestion, assimilation, and transport in sufficient quantity. The calabash is known for its energy values thus, its carbohydrate content have to do with this status in the nutrition. The results analyses of reducing sugar of calabash varieties studied here shows the similar trend to those obtained by Platt [21] work. In addition the work of Leung et al. [7] brought light on the nutritional value of calabash seed. Although the calabash in Sahel in one of their fruits consumption methods that is by boiling showed how people benefit from its nutritive, therapeutic and organoleptic values. The calabash varieties like its counterpart vegetables could be an important candidate for enriching children or age people foods due its richness in vitamins, minerals and energy [7, 9]. However, calabash is an example of food to fulfill one of these tasks of biology. It is often accepted that dieticians recommend increasing the consumption of complex carbohydrates from legumes, whole grains, vegetables and fruits, particularly to increase fiber intake [20, 22].

## 5. Conclusion

This study sheared light toward the possible understanding, the importance of reducing sugar as nutrient and the organoleptic properties of *L. siceraria* varieties. Despite of its socio-economic and cultural importance of calabash, studies of full characterization, valorization and

promotion of the production of this biological material are minimal.

## Conflict of Interest

We declare that we have no conflict of interest.

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