

Chemical Composition of Taro and Analysis of The Level of Its Consumption in The City of Niamey, Niger: Case of Madina And Koira Tégui District

RABIOU Maman Moustapha*, TCHICAMA Mella Mamane, SABO Haoua, MAAZOU Mahaman Sabiou, and SADOU Hassimi

Laboratoire de Nutrition et de Valorisation des Agro ressources,
Université Abdou Moumouni, Niger, West Africa.

*Correspondence:

RABIOU Maman Moustapha, Département de Chimie, Faculté des Sciences et Techniques, Université Abdou Moumouni, BP 10662 Niamey, Niger, Tel: 00 227 97 03 66 26; Fax: 00 227 20 31 58 62.

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ABSTRACT

In order to promote taro cultivation in Niger, an analysis of the level of its consumption and chemical composition was carried out. To this end, interviews were conducted with 70 consumers and 20 salespeople in Niamey. The chemical composition of two varieties of raw and cooked taro was determined by standard methods. The results obtained show that taro can be bought well in Niamey with sales of 2 to 3 bags of 100 kg/day/trader. According to the respondents, taro conservation does not require much care. Two varieties of taro that differ in size are mainly marketed. Taro is eaten after boiled, peeled and seasoned with spices. 98.57 % of consumers are unaware of the nutritional intake of taro. Analysis of the chemical composition of two varieties of raw and cooked taro shows that moisture contents vary from 79.33-88.15%, ash contents from 0.8-1.00%, fat contents from 0.74-1.12%, protein contents from 0.67-1.17% and carbohydrate contents from 14.20-23.88%. Cooked taro provides a total energy between 101.03 and 109.43 kcal/100g. With regard to mineral composition, the contents of Ca, K, Mg, Na, Fe and Zn expressed in mg/100g of fresh matter fluctuate from 2.31-2.89; 14.73-17.08; 24.36-25.10; 5.37-5.70; 0.27-0.30 and 0.24-0.34 respectively. The two varieties of taro studied have fairly similar nutrient contents. Cooking in water resulted in a significant increase ($p < 0.05$) in carbohydrate levels and a decrease in moisture, ash, K and Zn contents.

Keywords

Promote, Taro, Chemical composition, Niger.

Introduction

Niger is a sub-Saharan African country whose economy is based on agriculture, which accounts for 50% of GDP [1]. Almost all of this food agriculture is for self-consumption and subsistence economy. Although this situation remains a characteristic of "third world" or "southern countries" this type of agriculture remains very important because it represents about 20% of world food production [2]. Food insecurity is an almost permanent reality in Niger. It is due to natural constraints, in particular insufficient and irregular rains, poor soils, etc., but also institutional constraints. Indeed, most agricultural research institutions and extension

services have focused mainly on cereal crops with less attention on tubers [3]. Roots and tubers belong to the category of foods that mainly provide energy in the form of carbohydrates in the human diet. This designation applies to all plants whose roots, rhizome or underground tubers contain edible material [4].

In this study we focused on *Colocasia esculenta* known as taro. *C. esculenta*, an important staple food for millions of people, is grown exclusively in the tropical and semi-tropical regions of the world. It is mainly cultivated for its edible tubers [5]. In Niger, the production of *C. esculenta* is highly marginalized [6]. The objective of this study was to analyze the level of consumption of *C. esculenta* in the city of Niamey but also to determine its chemical composition.

Material and Methods

Plant material

It consists of two varieties of taro purchased at the market of the city of Niamey. One variety consists of small tubers and the other large tubers of taro. A quantity of small and large tubers of taro were cooked in simple water.

Chemicals and reagents

Sulfuric acid (98%), Kjeldahl catalyst, n-hexane (97%), sodium hydroxide (96%), hydrochloric acid (95%), boric acid (99, 5%) and calibrated solutions of mineral elements were purchased from Prolabo (France).

Survey method

Seventy (70) consumers and twenty (20) sellers of taro spread over two (2) districts of Niamey were surveyed. Madina and Koira Tégui are the two (2) districts concerned by these surveys. Consumer choice was random while sellers were selected according to their availability at the time of the survey.

Proximate analyzes

The analysis of the chemical composition was carried out on two varieties of raw and cooked taro after drying and grinding. The moisture content was determined by oven drying [7]. Ashes are obtained after dry mineralization of the previously dried mill [8]. Total proteins are determined according to the Kjeldahl reference method [9]. The lipids are extracted with soxhlet by percolation of hexane [10]. Total carbohydrates were estimated by difference: $100 - (\% \text{ moisture} + \% \text{ crude protein} + \% \text{ crude fat} + \% \text{ ash content})$. Energy was calculated according to the following equation: $\text{Energy (kcal)} = (\% \text{ proteins} \times 4) + (\% \text{ carbohydrates} \times 4) + (\% \text{ lipids} \times 9)$. The results of ash, protein, lipid and carbohydrate contents are reported on the basis of the fresh matter.

Mineral analyzes

The ashes are solubilized in hydrochloric acid. The contents of Ca, Mg, Zn, Fe, Mn and Cu were determined by atomic absorption spectrophotometry, Na and K by emission spectrophotometry [11, 12]. The results are reported on the basis of the fresh matter.

Statistical analysis

The statistical analysis was performed using Minitab version 16. The results were subjected to analysis of variance, and differences between the means were determined using the Tukey multiple comparison test. The difference is significant at $p < 0.05$.

Results and Discussion

Profile of taro sellers

Depending on the results of the survey, the age of the sellers varies from 20 to 60 years. The sale of taro is largely carried out by people between the ages of 41 and over. This age group represents 65%. According to the result obtained, 100% of the sellers are sex male.

Varieties and quantity of taro sold

The results of the survey show that 87.14% of consumers differentiate between the different taro varieties according to

organoleptic characteristics, particularly color and shape. Two varieties are mainly sold on the markets. They are distinguished by their size. Small taro tubers are the most sold by traders (65%) while large taro tubers are the least sold. These small taro are also the most requested by consumers (90%). 50% of salesmen, manage to sell two (2) to three (3) bags per day. According to these sellers, the 100 kg bag can be sold for up to 18,000 francs cfa (USD 31, 26).

Conservation and signs of deterioration of taro

The analysis of the survey results shows that 95% of sellers do not have knowledge of taro preservation methods. Among the sellers surveyed, 75% said that taro can be conserved for 5 to 7 days. According to the majority of these sellers, changes in odor and texture are the main signs of the beginning of taro deterioration. Indeed, 90% of sellers recognize the alteration of the taro by these changes.

Taro consumption

According to the survey result, 77.14% of respondents consume taro at least once a day during the period of its availability. Among the consumers surveyed, 75.71% do not prepare the taro themselves. The sale of cooked taro is therefore a significant source of income. The most commonly consumed form of taro is that boiled in simple water, peeled and seasoned with chilli pepper containing salt and flavour. According to most consumers, the reason for consuming taro is essentially pleasure. They represent 92.85% of consumers. Our result corroborates to 87% of consumers who consume taro for pleasure reported by [13]. For all consumers surveyed, taro does not have a pharmacological use and no disorders after consumption were found. Cooked taros are sold under poor hygienic conditions. Indeed, 75.71% of respondents confirmed that hygiene conditions at points of sale are fair. On these premises, the cooked taro is spread on trays not protected from flies and dust. These hygiene deficiencies among these sellers could be due to the low level of education because only 10% of the respondents have a primary level of education. Indeed, sellers do not have knowledge about the consequences of poor hygiene conditions for ready-to-eat food. In addition, they are not sensitized by hygiene and sanitation workers. These results are close to 62.5% of consumers who confirmed that hygiene conditions at potato sales are passable [14]. According to the results of our survey, 98.57% of consumers do not know the nutritional value of taro.

Proximate composition of taro

The physicochemical analysis results of two varieties of raw and cooked taro are presented in the table 1

Table 1 shows that the moisture content of taro varieties varies from 79.33 to 88.15%. The highest moisture content was observed in large taro tubers. These high moisture contents may explain the short conservation period of taro. After cooking in simple water, Table 8 shows that taro moisture contents decrease. This decrease is significant ($p < 0.05$) in large taro tubers. Small and large taro tubers after cooking have almost similar moisture contents. The moisture contents obtained are slightly higher than the 73.1 and

71.7% respectively for raw and cooked taro previously reported [15].

The ash content is an indicator of the mineral content. Ash contents vary from 0.80 to 1.00%. The highest ash content was found in small raw taro tubers. The contents obtained are in agreement with 1.2 and 0.97% respectively for previously reported raw and cooked taro [16]. After cooking in simple water, Table 1 shows a non-significant decrease in small taro tubers and a significant decrease ($p<0.05$) in large taro tubers. The decrease in ash content would be positively correlated with the solubility of certain minerals in water.

Nutriments	Small tubers of taro		Large tubers of taro	
	Raw	Cooked	Raw	Cooked
Moisture	81.74 ± 0.90b	79.33 ± 1.41b	88.15 ± 0.66a	79.94 ± 0.22b
Ashes	1.00 ± 0.037a	0.99 ± 0.00a	0.92 ± 0.00a	0.80 ± 0.04b
Proteins	1.17 ± 0.1a	1.02 ± 0.12ab	0.68 ± 0.04b	0.67 ± 0.11b
Lipids	0.95 ± 0.07ab	1.12 ± 0.02a	0.74 ± 0.063b	0.93 ± 0.04ab
Carbohydrates	21.38 ± 1.04a	23.80 ± 1.55a	14.20 ± 0.66b	22.47 ± 0.33a
Energy	98.83 ± 5.26a	109.43 ± 6.97a	66.28 ± 2.25b	101.03 ± 1.36a

There is no significant difference ($p>0.05$) between the averages that have the same letter in each column.

Table 1: Proximate composition (g/100 g) of varieties of raw and cooked taro.

Table 1 reports very low lipid contents, with the highest content not exceeding 1.2%. Small taro tubers have significantly higher lipid content ($p<0.05$) than large taro tubers. The lipid contents obtained are significantly higher than 0.2 and 0.11% respectively for the raw and cooked taros previously reported by [16]. Fat contents tend to increase in a non-significant way after cooking in water. The increase in fat content is partly due to the decrease in moisture content after cooking. The low fat content of taro indicates that it is a low-energy food. Indeed, taro provides a total energy between 66.28 and 109.43 kcal/100g.

The protein contents of two varieties of raw and cooked taro vary between 0.67 and 1.17%. These contents are close to 1.5 and 0.55% respectively for raw and cooked taro reported by [16]. Small taro tubers have significantly higher protein content than large taro tubers. Cooking taro in simple water has little influence on the protein content ($p > 0.05$). However, a downward trend was observed.

The carbohydrate content of two varieties of raw and cooked taro is between 14.20 and 23.80%. Small taro tubers have significantly higher carbohydrate contents ($p<0.05$) than large taro tubers. After cooking in water, a non-significant increase and a significant increase ($p<0.05$) in carbohydrate contents were observed in the small and large taro tubers studied, respectively. This increase in carbohydrate content is simply due to the decrease in moisture content in cooked taro. Indeed, if the carbohydrate content has

been reported on a dry matter basis, a decrease will be recorded. The decrease in carbohydrate content can be explained by the solubility of some carbohydrate compounds in water.

Mineral composition of taro

The results of the mineral composition of two varieties of raw and cooked taro are presented in Table 2.

Minerals	Small tubers of taro		Large tubers of taro	
	raw	cooked	raw	cooked
Calcium	2.89 ± 0.02a	2.81 ± 0.16a	2.65 ± 0.08ab	2.31 ± 0.15b
Potassium	15.97 ± 0.03a	14.73 ± 0.37b	17.08 ± 0.12a	16.78 ± 0.39a
Magnesium	24.95 ± 1.34a	24.78 ± 0.31a	25.10 ± 0.15a	24.36 ± 0.51a
Sodium	5.70 ± 0.14a	5.51 ± 0.44a	5.53 ± 0.09a	5.37 ± 0.03a
Iron	0.30 ± 0.01a	0.30 ± 0.00a	0.29 ± 0.01a	0.27 ± 0.01a
Zinc	0.27 ± 0.00a	0.26 ± 0.01a	0.34 ± 0.01b	0.24 ± 0.00a
Manganese	-	-	-	-
Copper	-	-	-	-

There is no significant difference ($p>0.05$) between the averages that have the same letter in each column.

Table 2: Mineral element content expressed in mg/100g of two varieties of raw and cooked taro.

Minerals are of great nutritional interest due to their health benefits [17]. In addition to their structural role, minerals are also agents of metabolic integration. Indeed, several minerals play the role of cofactors in enzymatic catalysis, thus ensuring essential physiological functions. The mineral element composition of two varieties of raw and cooked taro is reported in Table 2.

There is no significant difference between small raw taro tubers and large raw taro tubers except for the zinc content. Indeed, large raw taro tubers have significantly higher zinc content ($p<0.05$) than small raw taro tubers. The Mg and Zn contents obtained are quite similar to those reported by [16]. However, the Ca, K, Na, Fe, Fe, Mn and Cu contents reported by [16] are significantly higher than those obtained in the present study. Copper and manganese are present in trace form in our samples. The mineral content of plant products reflects the content of these different elements in the soil. The variation in mineral composition observed may be due to climate, species, soil type or cultural practices [18].

The analysis in Table 2 also shows the influence of taro cooking in water on the mineral content. Cooking in simple water did not have a significant effect on the Ca, Mg, Na and Fe contents of small taro and large taro tubers. For K and Zn, a significant decrease ($p<0.05$) was observed in small and large taro tubers respectively. This decrease may be related to the solubility of these minerals in water.

Conclusion

At the end of this study we can say that in Niamey, the level of taro consumption is very appreciable and that its marketing is a source of income. Taro is a food that has an interesting nutritional

intake, especially in mineral elements such as iron and zinc, whose deficiency is a public health problem in Niger. Overall, the method of preparing taro in simple boiled water has no significant effect on the determined nutrient contents. The two varieties of taros studied do not have a significant difference in mineral element content. From these results, it would be important to promote taro cultivation in the ecologically demanding areas adopted in Niger.

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