Short Research Article

Nutritional and mineral compositions of Tiger nut (Cyperus *Esculentus)* tubers from different ecotypes in Niger.

Abstract

Nutritional characterization is an essential component for a better knowledge of the different ecotypes of Niger tiger nut. To do this, 20 samples of tiger nut tubers were involved, including 5 ecotypes representative of the Niger tiger nut and 15 others randomly selected from the ecotypes collected in the producing villages in the Maradi and Dosso regions. The content of mineral elements was analyzed by atomic absorption spectrophotometer and the content of macronutrients determined by different types of assay. The results showed that the tiger nut ecotypes are rich in lipids (12% to 25.2%), carbohydrates (24.5% to 47.7%), fiber (21.9% to 39.4%) , protein (2.9% to 11.9%), and mineral elements such as calcium (14.10± 5.44a to 65.38± 19.94a), iron (0.881± 0.017b to 15.809± 6.524 a), potassium (102.80± 2.97d to 308.41± 8.90a), magnesium (366.80 ±1.942a to 471.83± 8.927a). The fat content is much higher in small tigernut ecotypes with an average of 21.6% than in large tigernut ecotypes with an average of 14.9%. The Copper (Cu), Sodium (Na), Calcium (Ca) and Magnesium (Mg) contents are significantly identical for all the ecotypes studied. On the other hand, the Zn, Iron, K contents of ecotypes E1(Big tigernut), E2 (Small tiger nut), E3(Small tiger nut), E4(Small black tiger nut), E5(Small wild tiger nut), E7(Small wild tiger nut), E8(Small tiger nut), E9(Small tiger nut), E11(Small tiger nut), E12(Small tiger nut), et E15(Big tigernut) are significantly higher compared to the other ecotypes. This study made it possible to obtain a better nutritional profile of Niger tiger nut tubers.

Keywords : Characterization, macronutrients, micronutrients, ecotypes, tiger nut, Niger

I. INTRODUCTION

Cyperus esculentus. L (Tiger nut) is a perennial monocotyledous plant which has a tough erect fibrous root. The slender rhizomes of tiger nut form weak runners above the ground level which develop small-sized tubers at the tip of the stem. Tiger nut tubers can reach about six inches depth into the soil. The size of the tubers can be compared with that of peanut. The central erect stem of tiger nut is usually covered by sheath of leaves [1].

In Niger, tiger nut is used in human food in different forms (biscuit, sweets, flour, milk, etc.) [2]. Also, the tiger nut, like most of these tubers, makes it possible to fight against malnutrition given their chemical composition and their medicinal properties [3]. Currently, malnutrition is a public health problem in the world. According to the report on global malnutrition 2017, published in November, all of the 140 countries studied are confronted with at least one of the main forms of this scourge: stunting, anemia in women of childbearing age and overweight in adults [4]. This malnutrition continues to plague the world in general and in developing countries (DCs) in particular [5]. The number of chronically undernourished people has increased by almost 56 million people in Africa (especially West Africa) [6]. In Niger, the prevalence of global acute malnutrition (GAM) is 16% in rural areas compared to 10.4% in urban areas, corresponding to a serious situation according to the WHO (World Health Organization) classification scale [7]. And yet, tiger nut tubers are eaten all over the country. Despite a wide knowledge of tiger nut tubers, no study on its physico-chemical composition has been made in Niger. It is therefore necessary to carry out a study on the nutritional and mineral composition of the tubers of the Niger tiger nut ecotypes for a rational use of the product and to fight against food and nutritional insecurity in Niger.

II. MATERIALS AND METHODS

2.1. Material

a) Plant material

The plant material is made up of twenty (20) samples (small and large) of tiger nut tubers including five (5) ecotypes produced during the trial on the agro-morphological characterization of the five ecotypes representative of the Niger tiger nut and the fifteen (15) others randomly selected from the ecotypes collected at the level of the producing villages of tiger nut in the regions of Maradi and Dosso (Table 1).

Table 1: Different ecotypes analyzed

Sample No.	Kinds	Collection place (	Regions
E1	Big tiger nut*	Trial(E1)/ FA	Niamey
E2	Small tiger nut*	Trial (E2)/FA	Niamey
E3	Small tigernut**	Trial (E3)/FA	Niamey
E4	Small Black Tigernut*	Trial (E4)/FA	Niamey
E5	Small Wild Tigernut***	Trial (E5)/FA	Niamey
E6	Small Black Tigernut	Maradi	Maradi
E7	Small Wild Tigernut	Rijiasamna	Dosso
E8	small tiger nut	Dommo	Dosso
E9	small tiger nut	Dalia	Maradi
E10	small tiger nut	Takalafia	Maradi
E11	small tiger nut	Dan Tsoutsou	Maradi
E12	small tiger nut	Gamozon	Dosso
E13	small tiger nut	Kimiakoara	Dosso
E14	small tiger nut	Dan Amina	Maradi
E15	big tiger nut	Dan Toudou	Maradi
E16	big tiger nut	RijiaSamna	Dosso
E17	big tiger nut	dan gamji	Maradi
E18	big tiger nut	Guidan Moussa	Maradi
E19	big tiger nut	Dan Sara	Maradi
E20	big tiger nut	Dan Amina	Maradi

: Maradi market, **: Dosso market; * : empty field , FA: faculty of agronomy*

2.2. chemical analysis methods

2.2.1 Determination of moisture content and dry matter

The moisture content was determined Into crucibles previously dried in an oven at 103° C for 30 min and cooled in a desiccator then weighed (P0), 5 g (TS) of the sample were introduced.

These crucibles are placed in an oven at 103°C for three hours, and then weighed at regular time intervals of 15 min until a constant weight is obtained. Thus, the moisture level was determined by the following formula:

% Moisture = TS – (FW – EW) / TS × 100

TS = test socket (5 g);

EW = empty weight of the crucibles;

FW = final weight (crucibles + EW).

The dry matter is obtained from this determination of the moisture content

% DM = 100 - % moisture

2.2.2 Determination of mineral matter (MM) and organic matter (OM)

Incineration was carried out to obtain all the cations (ammonium excluded) in the form of carbonates and other anhydrous mineral salts . To do this, crucibles are dried in an oven at 103°C for 30 min and cooled in a desiccator then weighed (TS). Next, 1 g (EW) of the sample are introduced into these crucibles and brought to incineration in a furnace at 550° C for 4 h. At the end of the incineration, the crucibles are removed and cooled in a desiccator for 30 min before being weighed (FW). The percentage of ash is given by the following relationship:

% MM = FW – TS/EW × 100

TS: test socket;

FW: final weight (crucible + sample);

EW: empty weight of the crucibles.

The total Organic Matter (OM) is obtained from the results of the mineral matter or ash. The organic matter content is thus equal to:

%OM= % (DM) - %MM

2.2.3 Dosage of fat

The determination of the fat content is carried out according to the Soxhlet extraction method using hexane as the solvent under reflux [8].The balloon is first washed and dried. The empty balloon weight (P1) is noted 5g (P2) of the sample is introduced into the extraction cartridges, then plugged with cotton and placed in the soxhlet. The flask is filled with approximately 300 ml of hexane and then connected to the soxhlet. The latter connected to a refrigeration system is connected to a cryostat to condense the solvent vapors intended to entrain the lipids. The extractions last 4 h. The hexane is recovered through a tap. The flask is dried in an oven at 105° C and cooled in a desiccator for 30 min then weighed. The fat content is obtained according to the following formula:

% Fat = (P3 – P0) /P2 × 100

P1 = mass of the empty balloon;

P3 = mass of the balloon containing the fat;

P2= test socket

2.2.4. Determination of total nitrogenous matter

The content of total nitrogenous matter or proteins is determined by the Kjeldahl method. The organic nitrogen of the sample to be analyzed is transformed into mineral nitrogen in ammoniacal form $(NH4)_2SO_4$ thanks to the oxidizing action of concentrated sulfuric acid in the presence of a catalyst. After displacement with sodium hydroxide (strong base added in excess), the ammonia is distilled then titrated in the presence of a reagent (boric acid) by acidimetry. The total protein content is calculated by multiplying the amount of nitrogen by a conversion factor (6.25), or 16% in protein.

The total nitrogen content (protein) is calculated by the following formula:

% protein= ((Cs – Cw) / TS× N × 0.014 × 100) × 6.25

Cs = cruet drop (sample)

Cw = cruet drop (white)

N = normality of the sulfuric acid used for the assay = 0.1

TS= test socket (0.2 g)

6.25 = conversion factor multiplying the amount of nitrogen to get the total protein content

0.014= molar mass of nitrogen × 0.001

2.2.5 Determination of crude fiber

The method makes it possible to measure by a double hydrolysis in animal feed the materials free of fat and insoluble in acid medium and in alkaline medium called crude cellulose. The assay was carried out according to the Weende method [9]. Indeed, the sample is successively treated with boiling solutions of sulfuric acid H_2SO_4 0.255 N and sodium hydroxide NaOH 0.313 N and washed, dried and then calcined. The weight loss resulting from the calcination corresponds to the crude cellulose of the test portion (1 g).A concentrated solution corresponds to 35.64 N To obtain a 0.255 N solution, 14.3 ml of concentrated sulfuric acid must be taken and made up to 2 l with distilled water.For 2l weigh 25.04g and top up with distilled water.

% Crude fiber = ((P2 – P3) / P1) × 100

P1: test socket (g)

P2: weight of the crucible + cellulose + mineral matter (g)

P3: weight of the crucible + mineral matter (g)

2.2.6 Carbohydrate levels

The rate of total carbohydrates is obtained from the following formula:

100-(moisture + fat + protein + ash + fiber) [9].

2.2.7 Dosage of mineral elements

The mineral elements (Ca, Na, K, Mg, Zn, Cu and Fe) were assayed from the ashes obtained by the incineration of flours from ground tubers. For each sample the contents of mineral elements are determined. In practice, the samples are mineralized, the extracts are prepared and the reading is made by atomic absorption and the calculation of the different values using a calibration curve.

2.2.7.1 Digestion and preparation of sample extracts

A quantity of 1 g of sample is weighed in a porcelain crucible then placed in the oven at 500° C for 3 h After cooling, 10ml of 1 molar nitric acid is added to the ash obtained and then evaporated completely on a hot plate at 100°C To the residue are added 5 ml of 0.1 molar hydrochloric acid. Evaporate to dryness on a hot plate, then study at 105°C for about an hour to insolubilize the silica. Take up with l ml of HCl at ½ filter, the crucible is rinsed twice with 10 ml of hydrochloric acid. The filtrate is brought to 50 ml in a volumetric flask [10, 11].

III.RESULTS

3.1 Macronutrient, dry matter and moisture content of the tubers of the ecotypes of the tiger nut studied

The results of the table 2 show that the moisture content of tiger nut tubers is relatively low, around 6%. The ash content (mineral matter) is on average 1.7% for the big tiger nut and 1.8% for the small tiger nut. The classification according to ecotypes shows that the ash content of ecotype E2 is highest (3%) and that ecotype E4 recorded the lowest ash content (0.2%).

The tiger nut is rich in dietary fiber with an average of 29.5% for the big tiger nut and 28.5% for the small tiger nut. The highest fiber contents were recorded for ecotypes E15 (37%) and E11 (39.4%). Ecotype E7 (small wild tigernut from Rijia Samna) is less rich in fiber (19.8%) compared to the other ecotypes (small and large tiger nuts).

The fat content is higher in all the ecotypes of the small tiger nut with an average of 21.6% than in the ecotypes of the large tiger nut whose average is 14.9%. The E11 and E9 ecotypes have a higher fat content (25.2%) compared to the other ecotypes. The low-fat content is recorded by ecotype E17 (12.0%).

The average protein content is 4.6% for the big sedge ecotypes and 5.5% for the small shoveler ecotypes. The E7 ecotype has a higher protein content (11.9%). For both types of tiger nut, the lowest protein content was recorded for ecotype E3 (3.1%). However, tiger nut ecotypes have carbohydrate levels ranging from 24.5% to 49.6%. The carbohydrate content has been raised for.

Table 2: Macronutrient, dry matter and humidity contents of the tubers of Small and Big tigernut ecotypes (%)

Kinds	**Ecotypes**	**F**	**MM**	**FAT**	**M**	**DM**	**P**	**OM**	**G**
Small tiger nut*	E2	28.8	3	20.6	6.4	93.56	6.4	90.56	34.8
Small tigernut**	E3	29.9	1.9	22.6	6.2	93.82	3.1	91.92	36.3
Small Black Tigernut*	E4	27.6	0.2	18.5	6.3	93.7	4.5	93.5	42.9
Small Black Tigernut	E6	27.7	1.1	23.7	6	94	2.9	92.9	38.6
Small Wild Tigernut	E7	19.8	2.3	17.1	7	92.98	11.9	90.68	41.9
small tiger nut	E8	32.5	1.5	18.8	6.5	93.5	8.6	92	32.1
small tiger nut	E9	24.6	2	25.2	6	93.98	5.4	91.98	36.8
small tiger nut	E10	25.2	1.2	23.2	6.4	93.56	9.3	92.36	34.7
small tiger nut	E11	39.4	1.2	25.2	6.1	93.92	3.6	92.72	24.5
Small Wild Tigernut***	E5	25.5	2.9	18.5	6.7	93.34	4.4	90.44	42
small tiger nut	E12	30	1.7	23.6	5.5	94.48	3.4	92.78	35.8
small tiger nut	E13	29.9	1.8	22.5	5.8	94.24	4.8	92.44	35.2
small tiger nut	E14	28.9	1.9	21.1	5.3	94.66	3.2	92.76	39.6
Mean of smalls tiger nuts		**28.5**	**1.8**	**21.6**	**6.2**	**93.8**	**5.5**	**92**	**36.4**
Big tigernut	E15	37	0.8	14.3	6.5	93.5	4.6	92.7	36.8
Big tigernut	E1	27.4	1.9	16.5	7	93	4.6	91.1	42.6
Big tigernut	E16	21.9	2.6	15.8	6.9	93.1	5.1	90.5	47.7
Big tigernut	E17	30.5	0.5	12	6.5	93.5	4.1	93	46.4
Big tigernut	E18	24.1	2.5	13.9	5.8	94.2	4.1	91.7	49.6
Big tigernut	E19	33	1.8	16	6	94	6	92.2	37.2
Big tigernut	E20	32.7	1.9	15.8	5.8	94.2	3.4	92.3	40.4
Mean of big tiger nuts		**29.5**	**1.7**	**14.9**	**6.3**	**93.7**	**4.6**	**92**	**43**

Legend: F: fibers, MM: mineral matter, fat (lipids), P: protein, OM: organic matter, C: carbohydrates, M: Moisture, DM: dry matter

3.2 Mineral element content of the tubers of the tiger nut ecotypes studied

The composition of the tiger nut in mineral elements (Table 3) is very variable at the level of the two types of ecotypes (small and large tiger nut) but also within the same types. The results of Table III show that most of the mineral elements have higher contents for the ecotypes of the small tiger nut than for the ecotypes of the large tiger nut.

The Copper (Cu), Sodium (Na), Calcium (Ca) and Magnesium (Mg) contents are significantly identical for all the ecotypes studied. The Zn contents of the E2 (2.4361±0.7261a mg/100g) and E3 (2.4349±0.6123amg/100g) ecotypes of tiger nut are significantly higher compared to the other ecotypes. The Zn contents of the ecotypes of the big tiger nut E19 (0.6757± 0.4510bmg/100g) and E20 (0.8386± 0.3169bmg/100g) are significantly lower. The iron content of ecotype E7 (15.809± 6.524 a mg/100g) is highly significant compared to the ecotypes studied. However, the E1, E2, E3, E4, E5, E8, E9, E11, E12 and E15 ecotypes are distinguished with respectively significantly identical iron contents of : 5.969 ± 3.112ab; 11.406± 5.780ab; 10.877± 5.134ab; 10.961±5.612ab; 5.338±5.159ab; 2.982± 1.758ab; 4.029± 2.469ab; 3.157± 2.108ab; 5.063± 2.600ab and 3.139± 2.134abmg/100g. The k content is significantly higher for all tiger nut ecotypes. It is highly significant for ecotypes E2 (308.41± 8.90amg/100g), E3 (288.24±8.32abmg/100g) and E15 (300.25± 8.67amg/100g). Finally, the ecotypes are distinguished by the compositions of the three elements (Zinc, Iron and Potassium).

Table 3: Contents of mineral elements in the tubers of the tiger nut ecotypes (mg/100g)

Ecotypes	**Cu**	**Na**	**Ca**	**Zn**	**Fe**	**K**	**Mg**
E1	0.2331± 0.0309a	4.909± 0.748a	28.85± 15.4a	1.2108± 0.4649ab	5.969± 3.112ab	112.89± 3.26ij	372.15± 3.707a
E2	0.5025±0.0618a	3.776± 1.282a	65.38± 19.94a	2.4361± 0.7261a	11.406± 5.780ab	308.41± 8.90a	411.73± 7.338a
E3	0.3969± 0.0361a	5.514± 0.748a	41.67± 13.60a	2.4349± 0.6123a	10.877± 5.134ab	288.24± 8.32ab	456.49± 6.052a
E4	0.2425± 0.0278a	8.157± 3.418a	42.31± 25.38a	1.9936± 0.4367ab	10.961± 5.612ab	112.89± 3.26ij	406.21± 1.967a
E5	0.3769± 0.0850a	5.363± 0.320a	20.51± 10.88a	1.1708± 0.4925ab	5.338± 5.159ab	243.56± 7.03def	408.70± 2.724a
E6	0.1202± 0.0258a	5.211± 0.107a	34.62± 19.94a	1.0296± 0.3068ab	2.451± 1.314b	154.69± 4.46gh	439.55± 3.404a
E7	0.3099± 0.0829a	5.211± 0.320a	52.56± 38.07a	1.4239± 0.3177ab	15.809± 6.524a	102.80 2.97d	471.83± 8.927a
E8	0.2586± 0.0361a	5.363± 0.320a	43.59± 16.32a	1.3635± 0.3164ab	2.982± 1.758ab	259.89 7.50cd	433.13± 4.312a
E9	0.1784± 0.0361a	4.683± 0.427a	24.36± 10.88a	1.1461± 0.2192ab	4.029± 2.469ab	232.03± 6.70ef	387.48± 4.363a
E10	0.1529± 0.0258a	4.909± 0.320a	21.15± 20.85a	1.9271± 0.4827ab	0.881± 0.017b	162.37± 4.69g	370.36± 6.985a
E11	0.4825± 0.5021a	5.211± 0.320a	29.49± 14.50a	1.1108± 0.3655ab	3.157± 2.108ab	251.25± 7.25cde	382.49± 4.665a
E12	0.2658± 0.0361a	6.344± 1.068a	20.51± 7.25a	1.3266± 0.4745ab	5.063± 2.600ab	224.82± 6.49f	366.80 1.942a
E13	0.2549± 0.0412a	6.495± 1.495a	19.23± 7.25a	1.2990± 0.4075ab	2.399± 1.189b	273.82± 7.90bc	438.48± 3.556a
E14	0.4989± 0.5305a	5.136± 0.214a	33.97± 17.22a	1.0256± 0.3992ab	2.365± 1.038b	222.90± 6.43f	443.12± 4.413a
E15	0.5408± 0.5742a	4.305±	28.21±	0.9392±	3.139±	300.25± 8.67a	440.44±

		1.175a	19.94a	0.4733ab	2.134ab		3.278a
E16	0.2349± 0.0695a	5.060± 0.320a	14.10± 5.44a	0.8686± 0.3033ab	2.560± 1.160b	161.89± 4.67g	449.18± 7.086a
E17	0.4006± 0.0773a	6.042± 1.068a	16.67± 5.44a	0.7732± 0.3226ab	1.085± 0.458b	168.14± 4.85g	399.79± 3.984a
E18	0.1593± 0.0708a	5.211± 0.107a	16.03± 4.53a	0.6618± 0.2491ab	2.133± 0.967b	177.26± 5.12g	470.22± 9.154a
E19	0.0046± 0.0005a	7.175± 1.389a	15.38± 5.44a	0.6757± 0.4510b	1.932± 1.451b	134.51± 3.88hi	413.87± 1.992a
E20	0.0037± 0.0040a	6.722± 1.816a	23.08± 5.44a	0.8386± 0.3169b	1.807± 1.428b	242.60± 7.00def	454.89± 6.279a

Values are means (n=2) ± SD. Values with the same letter in the same column are not significantly different ($p < 0.05$)

VI. DISCUSSION

Tiger nut tubers, whether small or large, have an average humidity rate of about 6%. The results support those of [12, 13, 14] in their respective studies on the physico-chemical characterization of the three morphotypes of tiger nuts with humidity levels of 5.19 ± 0.18%; 4.56 ±0.22%, 4.99 ± 0.78% and 8,30 ± 0,1 à 8,60 ± 0,17%. Also, on the characterization of four tiger nut ecotypes with 8.66a ±0.04%, 7.75b ±0.27%, 6.38c ±0.45% and 7.45b ±0.31%. Higher humidity levels were recorded by [15] (9.23%) and by [16] (9.73%). The variation in moisture content could depend on the degree of drying after harvest.

The average fat contents obtained are 14.9% for the ecotypes of the big tiger nut and 21.6% for the ecotypes of the small tiger nut. These results are corroborated by those of [17] who obtained a fat content in tiger nut between 18.23 ± 0.01% and 22.15 ± 0.03% depending on the “varieties” studied. However, the E11 and E9 ecotypes have much higher fat contents (25.2%) but close to the contents obtained by the [18] (25.6%); [19] (25.40%); [20], (24.45%) and [12] (26.14%). Moreover, these contents are lower than those of [21] who obtained contents ranging from 26.88 ± 3.32% to 44.92 ± 0.76b%; from [22] on the yellow and brown varieties whose respective contents are 32.13 and 35.43% and from [23], which is 32.8%.

However, the fat contents of the ecotypes of the tiger nut analyzed remain higher than those contained in certain tubers such as cassava (0.1 to 0.8%) [24] cited by [15], taro (0.33 to 1.17%) [25] and sweet potato (0.9%) [26]. Cereals such as millet and sorghum also contain respectively lower contents (5.14 to 5.96%) [27] and 2.40% to 10.54% [28,29].

The average dietary fiber contents of the ecotypes are 29.5% and 28.5% for those of the big tiger nut and the small tiger nut respectively. These results are close to those of [20 ,30]. Our results are higher than the fiber content obtained by [18] (11.7%) and very different from those of [17] and [31] who obtained grades ranging from 5.40 ± 0.01% to 8.63a ± 0.03% and 8.91%. Indeed, the ecotypes of Niger tiger nut contain a higher fiber content than yam and cassava, which contain 3.14% and 3.66% respectively [15]. On the other hand, this content is much higher than those of cereal flours such as wheat, millet, sorghum and maize, the contents of which vary respectively between 1.5 and 2%; 1.5 to 2.3% and 1.5 to 1.8% [15, 27, 28]. The difference in the levels observed can be explained by the fact that the present study considered whole tubers (skin with flesh) whereas in the studies mentioned, the authors only used tuber flour. These fiber contents of the ecotypes studied give tiger nut tubers interesting properties in terms of digestion [15].

The protein contents obtained vary from 2.9% to 11.9% for the ecotypes of two types of tiger nut (large tiger nut and small tiger nut) studied. These results show a fairly good protein profile. Also, these contents are consistent with those of [13] and [32] with protein contents ranging from 3.28±0.10% to 8.45±0.20% and 3,43±0,05b to 8,35±0,22d; [31] (5.04%); that of the [18] which is 4.8±1.1%; those of Nigerian varieties which vary from 7.15 to 10.50% [22, 19] and those of the samples from Côte d'Ivoire studied by [3]. This observed variability in protein content may be due to climatic and soil conditions [15].

Tigernut tubers contain a high rate of carbohydrate content with an average of 43% for large tigernut ecotypes and 36.4% for small tigernut ecotypes. These contents are similar to those of [21] which are between 52.2 ± 0.95c% and 42.14 ± 0.04b% and are higher than that obtained by [33] which is 19.40 ± 0.11%.

The mineral element composition of the studied ecotypes is significantly similar for copper (Cu), sodium (Na), calcium (Ca) and magnesium (Mg). However, they differ for Zinc (Zn), Iron (Fe) and Potassium (K). The Cu, Ca, Zn, Fe and K contents obtained for most of the ecotypes studied are consistent with those obtained by the [18]. These results are consistent with those of [12] with Cu (0.430±0.01c to 0.71±0.03a), Ca (22.13±1.64b to 32.27± 5.66a), Zn (1.88± 0.22b to 2.7±0.03a), and in Fe (3.570.17c ± 11.44 ±0.48a). The Na contents (3.776±1.282a to 7.175± 1.389a) obtained for all the ecotypes are lower than the content obtained by the [18] but with higher Mg contents (366.80 1.942a to 471.83± 8.927 a) than those obtained by [18,15] (102, 104.9 ± 0.67). the Mg (895,79±41,94 to 1344,98±69,30) and K (418,73 ±41,46 to 944,60 ±48,57) contents obtained by [32] in their study on 9 ecotypes of tiger nut of Burkina Faso are superior. The differences in the contents of mineral elements observed could be linked to the composition of the soil which can influence the absorption and storage of these elements in the tubers [12]. Ecotypes E1, E2, E3, E4, E5, E7, E8, E9, E11, E12 and E15 differ from other ecotypes due to their high Zn, Fe and K contents.

The tiger nut tubers of certain ecotypes studied are richer in iron than other foods, in particular the leaves of *Moringa oleifera* (3.81 ± 0.12mg/100g), *vigna unguiculate L.* (7.80 ± 0.15cmg/100g) and the leaves *of Hubicus sabdariffa (8.27* ± 1.01bmg/100g) mentioned by [34]. The composition of mineral elements such as copper, iron, zinc, calcium, and the fiber and protein compositions of the potato obtained by [18] are lower than that of the tubers of the studied tiger nut ecotypes.

V.CONCLUSION

The chemical composition of the tubers of the tiger nut ecotypes studied is highly variable. Ecotypes E1, E2, E3, E4, E5, E7, E8, E9, E11, E12 and E15 differ from the other ecotypes in relation to their content. However, the wild E7 ecotype recorded a higher Fe content than the other ecotypes. In addition, this study resulted in a better nutritional profile for the Niger tiger nut tubers. Indeed, these tubers have high levels of lipids, carbohydrates, proteins and mineral elements. Nevertheless, the high fiber content noted can be reduced during the technological operations. This nutritional composition can promote the incorporation of cultivated and/or wild tiger nut tubers into the diet of the population of Niger. Because these processed tiger nut tubers used alone as ingredients in certain dishes and or used as a food supplement will contribute to improving the nutritional status of populations.

Declarations

Competing interest

The authors have no relevant financial or non-financial interests to disclose.The authors have no competing interests to declare that are relevant to the content of this article.All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.The authors have no financial or proprietary interests in any material discussed in this article.

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