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RESEARCH ARTICLE

MINERALOGICAL COMPOSITION OF THE FRUITS OF LOCAL EGGPLANT CULTIVARS AMENDED WITH CHICKEN DROPPINGS IN CONGO BRAZZAVILLE

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ABSTRACT

The local aubergine is a vegetable and fruit rich in mineral elements, but the importance of these elements is unknown to Congolese consumers. The aim of the study was to assess the mineral content of aubergine fruit from plants fertilised with chicken droppings. The fruits of three cultivars (C1, C2, C3) of Solanum aethiopicum L. and cultivar C4 (Solanum macrocarpon L.), harvested from plants fertilised with 100 g, 200 g and 300 g of chicken droppings per bunch, were weighed and dried to obtain the water content. The dried fruits were ground to obtain fine powders. The powders were analysed for mineral elements using X-ray fluorescence spectrometry. Water contents of 91.49% and 87.20% were obtained with fruit from cultivars C3 and C4 fertilised with 100 g and 300 g of chicken droppings. A total of 48 mineral elements were identified, with levels varying according to cultivar. For 200g of chicken droppings, the C4 cultivar contained 3.31% potassium, 1.07% calcium and 0.36% magnesium. These levels are higher compared with C1 (2.60%; 0.38%; 0.33%), C2 (2.91%; 0.38%; 0.29%) and C3 (2.86%; 0.40%; 0.31%), fertilised with the same dose. Our results show that consumption of aubergine fruit fertilised with 200g of chicken droppings per packet provides the human body with potassium, phosphorus, calcium and magnesium, thereby toning it.

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INTRODUCTION

Aubergines are herbaceous plants from Salicaceae family which are related to tomatoes and potatoes. Its leaves and fruit can be used by the people for the consumption. Also, aubergine fruit is very rich in micronutrients. It contains compounds with high antioxidant potential and is effective in reducing glycaemia and cholesterol (Apak *et al*., 2007). After cooking, this fruit is low in calories but rich in water and fibre, with a good concentration of minerals (potassium, copper, manganese and selenium) and vitamins, mainly those in the B group (B1, B6 and B9). However, it is low in vitamin C and lacks vitamins D and B12 (Stevels, 1990). These fibre-rich vegetables have a low glycaemic index. In addition, they contain antioxidant compounds that can also reduce the rise in blood sugar levels after a meal and, in some cases, even prevent from hypertension. Aubergine fruit is also rich in polyphenols, which help to partially block the action of a digestive enzyme, lowering the glycaemic index and reducing the rise in blood sugar levels (Mandal, 2010). Also, its antioxidant effect helps limit oxidative stress, which is a limiting factor in type 2 diabetes (Doganlar *et al*., 2002; Terry, 2011).

It provides good proportions of copper, manganese and selenium, which have antioxidant properties (Doganlar *et al*., 2002). Thanks to its high nutrient content, aubergine fruit is one of the most widely consumed fruiting vegetables in the Republic of Congo (Henk, 2004; Tchiengang and Kitikil, 2004; Mialoundama *et al*., 2005). Its leaves and fruit are an essential ingredient in Congolese menus. This foodstuff, which is produced for subsistence and market gardening, does not meet the population's needs. This is reflected in its high price on the Brazzaville markets. This situation is due partly to low yields, which are largely dependent on the seasons, and partly to the fact that growers do not master the technical itinerary. The heavy human pressure on the soil in the peri-urban areas of Brazzaville is another factor making the situation worse. In recent decades, the degradation of agricultural soils has become a significant global issue. These areas, where market gardening is carried out, have not been spared. Soil degradation is caused in part by poor farming practices, leading to a decline in soil fertility and a number of environmental impacts (Prasannakumar *et al*., 2011). Degraded soil is characterised by a significant loss of nutrients and a drop in water availability for plants. The use of chicken droppings is a sustainable alternative to the use of synthetic fertilisers to improve soil balance.

This material recovers lost nutrients such as nitrogen and phosphorus to improve the physico-chemical and microbiological properties of the soil (Gilley &Eghball, 2002). The use of organic matter, which has little commercial value, contributes to sustainable agriculture that respects human health and the environment. These organic materials would meet the socio-economic requirements of consumers in terms of nutritional quality, the availability of aubergine fruit or leaves on the market and soil conservation. Chicken droppings are an excellent organic fertiliser for crops and could have the same impact as the mineral fertiliser NPK. The nitrogen contained in chicken droppings is rapidly available to the plant. The same applies to the other fertilising elements it contains. They can be used as a fertiliser rich in nitrogen, phosphorus, potassium and calcium, with a basic soil amendment effect (Gazeau *et al*., 2012). Although chicken droppings would improve the availability of aubergine fruit or leaves on the market, Congolese consumer producers are unfortunately unaware of their contribution to production techniques. To the best of our knowledge, the study of aubergine fruit from plants fertilized with chicken droppings has not been done yet. The aim of the study was to assess the mineral content of aubergine fruit from plants fertilized with chicken droppings. The rest of the paper is organized as follows: In section II, materials and methods are presented. We discuss the results in section III. The conclusion is presented in section IV.

MATERIALS AND METHODS

Plant material: The plant material used here, is consisted of the fruits of three cultivars of *Solanum aethiopicum* L. and one cultivar of *Solanum macrocarpon* L. For *Solanum aethiopicum* L, these were cultivars C1, C2 and C3, differentiated by the shape and colour of the fruits, as shown in (Figure 1a, b and c). Also, Cultivar C4 (d) of Solanum macrocarpon L.is shown in (Figure 1d). These fruits were freshly harvested at taste maturity from plants fertilized or not with doses of 100 g, 200 g and 300 g of chicken droppings per bunch.

Organic fertilizer: The fertiliser was chicken droppings. These droppings came from the poultry farm of the Institut Nationale de Recherche Agronomique in Congo- Brazzaville. They were added to the bottom of the pots at doses of 100g, 200g and 300g. This was a one-off application. An absolute control with no fertilisation was taken into account.

METHODS

Assessment of water content: Before determining the mineralogical composition of aubergine fruits, the water content was assessed on a sample of 25 fruits of each cultivar. The fruits were weighed using a precision balance to obtain the fresh weight, then dried in an oven at 70°C until a constant weight was obtained, which constituted the dry weight.

The water content in relation to the fresh weight is calculated using the following formula:

$$\mathrm{Te}\ (\%) = \frac{\mathrm{Pf} - \mathrm{Ps}}{\mathrm{Pf}} \mathrm{x}100$$

Te = water content
Pf = fresh weight or initial mass before drying
Ps = dry weight or final mass after drying

The water content in relation to the wet mass is expressed as a percentage

Preparation of aubergine powders and dosage of mineral elements: Fruit freshly harvested in the field was oven-dried at 70°C for 5 days. After cooling, the dried fruit was ground in a porcelain mortar. The crushed material was sieved through a 500 µm sieve to obtain a powder. The powder obtained was stored in brown bottles tinted at laboratory temperature. The powder was sent to analysis of PETROCI and research center (Abidjan, Côte d'Ivoire) for analysis using X-ray fluorescence spectrometry (XFRS) to determine the mineralogical composition of aubergine fruit from local cultivar plants. The powder obtained was first ground to a very fine powder using a RETSCH MM400 vibro-grinder, and then 4 g of sample and 1 g of binder powder were mixed. This mixture was homogenised in a pillbox using the vibratory mill. Pellets of this mixture were made using the hydraulic press. In addition, these pellets were analysed using X-ray fluorescence spectrometry or XRF.

Data analysis: XLSTAT software was used for the statistical analysis. The analysis of variance was based on the mean water content of fruit harvested from aubergine cultivar plants fertilised with four doses of chicken droppings. The normality of the residuals and the homogeneity of the variances were verified. Comparisons between means were made using the Student Newman and Keuls test with a threshold of 5%.

RESULTS

Moisture content of aubergine fruit harvested from plants fertilised with chicken droppings: Figure 2 shows the water content of fruit from local aubergine cultivars harvested at taste maturity from both fertilised and unfertilised plants. The results revealed a variation in water content depending on the cultivar. Also, the fruits of cultivar C3 showed higher water content than those of cultivar C4. A decrease in water content was noted on plants fertilised with high doses of chicken droppings in fruit from cultivars C3, C4 and C2. For cultivar C3, the water content was 91.49% on fruit harvested from plants fertilized with 100 g of chicken droppings. This content was higher at 91.34% and 90.99% on fruit from plants amended with 200g and 300g of chicken droppings. Water contents of 87% and 88% were recorded on C4 cultivar plants fertilised with 300g and 100g of chicken droppings, respectively. These contents were lower than the 89% observed in unfertilized plants. With fruit from cultivar C2, the 89% water content in plants amended with 300 g of chicken droppings was lower than the 90% observed in plants amended with 100 g of chicken droppings. However, in cultivar C1, the addition of chicken droppings increased the water content of aubergine fruit, as indicated in Figure 2. Table I shows the statistical results for the water content of local cultivars of Solanum sp as a function of the dose applied to the plants. The results show that there is a significant difference between the cultivars and the doses of fertilisation applied to the plants, since the P-value is below the 5% threshold. The analysis of variance enabled us to distinguish 5 groups in terms of the water content of fruit harvested from plants fertilised with chicken droppings. The lowest water content of 86.09% was the first group represented by plants of cultivar 4 fertilised with 200 g of chicken droppings.

Figure. 1 Fruits of local aubergine cultivars at taste maturity. Solanum aethiopicum L. C1, (b) Solanum aethiopicum L., C2, Solanum aethiopicum L. C3 and (d) Solanum macrocarpon L C4

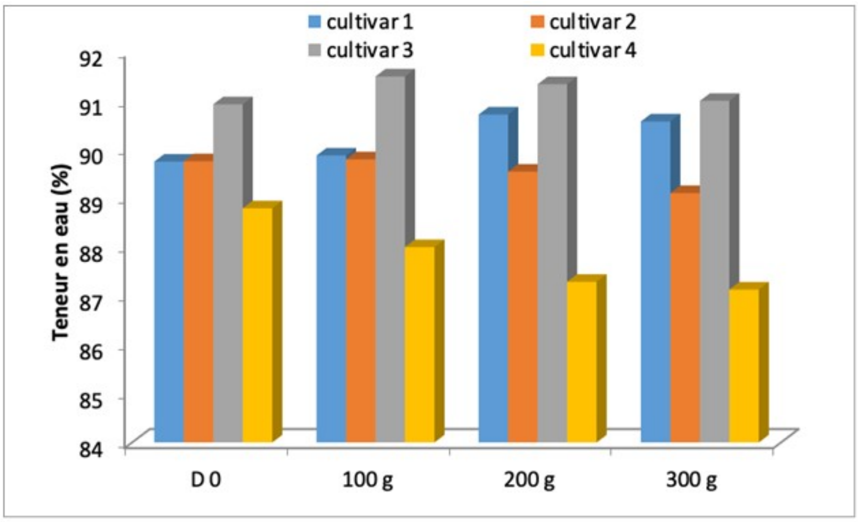

Figure 2. Occurrence of water (%) in fruit of aubergine cultivars harvested from plants amended with chicken droppings. dose 0: unfertilized plants; dose 1: plants fertilized with 100 g; dose 2: plants fertilized with 200 g and dose 3: plants fertilized with 300 g

The most significant effect was observed in cultivar C3 amended with 100 g of chicken droppings.

Occurrence of mineral elements in fruits of cultivar C1 fertilised with chicken droppings: The mineral content of fruits of cultivar C1 (*Solanum eathiopicum* L.) harvested from plants fertilized with chicken droppings is shown in Table 2.

These results show an increase in potassium, phosphorus and sodium content with increasing doses of chicken droppings. For these chemical elements, the contents of 2.67%, 1.08% and 0.07% observed in the fruit harvested from plants fertilized with 300 g of chicken droppings were higher than 2.52%, 1.01% and 0.06% observed in plants amended with 100 g of chicken droppings.

Table 1. Classification of fruit water content in aubergine cultivars fertilised with chicken droppings

Treatment	Water content	CV(%)
C1D0	89,75bc	0,380
C1D1	89,87bc	0,379
C1D2	90,71de	0,376
C1D3	90,57de	0,377
C2D0	90,56de	0,377
C2D1	89,99bcd	0,379
C2D2	89,54cd	0,381
C2D3	89,00c	0,383
C3D0	90,92de	0,375
C3D1	91,49e	0,373
C3D2	91,34de	0,375
C3D3	90,99bcd	0,377
C4D0	88,79de	0,384
C4D1	87,997b	0,388
C4D2	86,09a	0,396
C4D3	87,13b	0,391

Means not followed by the same lower-case letter are statistically different at the 5% threshold (P<0.05). C1: cultivar 1; C2: cultivar 2; C3: cultivar 3; D0: unfertilized plants; D1: plants fertilized with 100 g; D2: plants fertilized with 200 g; D3: plants fertilized with 300 g; CV: coefficient of variation.

The addition of 200 g of chicken droppings was optimal for calcium (0.38%), magnesium (0.33%) and chlorine (0.24%) content. For these elements, the addition of 300g of chicken droppings reduced their content. On the fruit of plants amended with 300g, 200g and 100g of chicken droppings, potassium levels of 2.67%, 2.60% and 2.53% were recorded. These levels were raised to 2.52% in the unfertilized plants. Thus, the addition of chicken droppings improved the potassium content of the plants. The addition of 200g of chicken droppings increased the micro-element content of fruits from cultivar C1 (*Solanum eathiopicum*L.). This cultivar was found to have a high sulphur and silica content. Sulphur levels of 59,000 and 64,000 ppm were noticed in the fruit of plants fertilised with 100, 200 and 300 g of chicken droppings. The level was 54,000 ppm in fruit from unfertilised plants. The 13 other microelements had levels of less than 0.1% regardless of the dose of chicken droppings applied to the plants. Molybdenum, selenium and vanadium were only present in trace amounts.

Table II. Mineral element content of fruits of cultivar C1 (*Solanum eathiopicum* L.) harvested from plants amended with three doses of chicken droppings

Mineralelements		Addition of chicken droppings per batch			
		0g	100g	200g	300g
Macroelements (%)	Potassium	2,52	2,53	2,60	2,67
	Phosphorus	1,00	1,01	1,04	1,08
	Sodium	0,05	0,06	0,06	0,07
	Calcium	0,28	0,34	0,38	0,28
	Magnesium	0,31	0,31	0,33	0,27
	Chlorine	0,17	0,23	0,24	0,18
		4,33	4,48	4,57	4,63
Microelements (ppm)	Chromium	20,4	13,3	16,7	14,4
	Sulphur	540	5900	5900	6400
	Silica	772,2	1478	994,6	960,4
	Iron	79,9	77,3	86,2	73,9
	Zinc	34,8	39,4	39,9	39,7
	Manganese	20,2	21,2	21,8	21,4
	Copper	17,5	18,3	18,9	19,1
	Bromine	5,2	6,7	9,9	5,6
	Nikel	3,2	4,2	4,8	4,7
	Molybdenum	0,9	0,9	0,8	0,5
	Selenium	0,5	0,5	0,5	0,5
	Iodine	22,6	25,7	29,5	23,4
	Tin	35,3	42,6	43,6	34,3
	Cobalt	3,9	3,9	3,9	3,9
	Vanadium	1	2,7	2,9	2,6
		643	752	761	751

Occurrence of mineral elements in C2 cultivar fruit fertilized with chicken droppings: Table III shows the macro and micro-element content of fruit from the C2 cultivar (*Solanum eathiopicum* L.) harvested from plants fertilised with chicken droppings. We have noticed a significant improvement in the macro-element content of fruit harvested from plants fertilised with 200 g of chicken droppings. In addition to that, the 4.61% content observed was higher than 4.08% recorded on fruit harvested from plants amended with 300 g of chicken droppings. With cultivar C2, the potassium content was higher with all doses of fertiliser. Levels of 2.18%, 2.29% and 2.91% were recorded on fruit fertilised with 100, 200 and 300g of chicken droppings. These levels were higher compared with 2.08% on unfertilised plants. The addition of chicken droppings increased the micro-element content of the aubergine fruit. A dose of 200g of chicken droppings was optimal. At this dose, the micro-nutrient content was 720 ppm. The fruits of cultivar C2 (*Solanum eathiopicum* L.) showed a preponderance of sulphurand silica out of the 15 microelements identified. Silica levels of 728 ppm were recorded on fruit harvested from plants fertilised with 200 g of chicken droppings. Sulphur levels of 600, 620 and 640 ppm were recorded in fruit harvested from plants fertilised with 100, 200 and 300 g of chicken droppings. These levels were higher at 570 ppm in unfertilised plants. For the 13 other microelements, it can be noticed a high iron content regardless of the dose of chicken droppings applied to the plants. Molybdenum, selenium and vanadium were only present in trace amounts.

Table 3. Mineral element content of fruit of cultivar C2 (*Solanum eathiopicum* L.) harvested from plants amended with three doses of chicken droppings

Mineralelements		Addition of chicken droppings per batch			
		0g	100g	200g	300g
Macroelements (%)	Potassium	2,08	2,18	2,91	2,29
	Phosphorus	0,84	0,96	0,99	0,89
	Sodium	0,02	0,04	0,04	0,03
	Calcium	0,30	0,35	0,38	0,35
	Magnesium	0,24	0,26	0,29	0,23
	Chlorine	0,17	0,17	0,20	0,18
		3,74	3,89	4,61	4,08
Microelements (ppm)	Chromium	13,1	18,4	18,6	13,2
	Sulphur	570	600	620	640
	Silica	530,8	630,7	727,6	566,7
	Iron	73,4	78,5	80,2	79,9
	Zinc	37,8	41,3	44,3	41,8
	Manganese	20,2	21	23,4	17,9
	Copper	14,5	17,7	18,1	17,5
	Bromine	5,7	6,2	6,6	7,2
	Nikel	3,5	3,8	3,9	3,7
	Molybdenum	0,5	1,3	1,5	0,3
	Selenium	0,5	0,5	0,5	0,5
	Iodine	24,1	34,7	35,4	24
	Tin	38,2	55,3	64,2	39,3
	Cobalt	3,9	3,9	3,9	3,95
	Vanadium	1,6	1,8	1,8	
		640	660	720	690

Occurrence of mineral elements in fruits of cultivar C3 fertilised with chicken droppings: Table IV presents the mineral content of fruits of cultivar C3 (*Solanum eathiopicum* L) harvested from plants fertilized with chicken droppings. There was an improvement in the macro-element content of fruit harvested from plants fertilised with chicken droppings. With the exception of chlorine, 200 g of chicken droppings was the optimum dose for this observed improvement. At this dose, potassium, phosphorus and phosphorus levels were 2.81%, 1.18% and 0.40%, respectively.

For macroelements, potassium levels were highest at 2.36%, 2.46% and 2.81% for fruit harvested from plants fertilised with 100, 200 and 300g of chicken droppings. These levels were higher at 1.93% in unfertilized plants. The sodium content was present in trace amounts. In general, macroelements were present at levels of 4.56%, 4.83% and 4.51% in the fruit of plants fertilised with 100, 200 and 300 g of chicken droppings.

For microelements, the addition of 200 g of chicken droppings improved the content of aubergine fruit. With this addition, sulphur, silica, iron and zinc levels of 750, 395, 82 and 41 ppm were recorded in C3 cultivar fruits fertilised with chicken droppings. These levels were higher at 510, 317, 71 and 31 ppm in fruit harvested from unfertilised plants. The highest level was observed for sulphur. Sulphur levels of 730, 750 and 720 ppm were recorded in fruit harvested from plants amended with 100, 200 and 300 g of chicken droppings. Molybdenum, selenium and vanadium were only present in trace amounts. In summary, microelement contents of 678, 890 and 680 ppm were observed in the fruit of plants fertilised with 100, 200 and 300 g of chicken droppings. These levels were higher compared with 580 ppm in the control plants, as seen in Table IV.

Table IV. Mineral element content of C3 cultivar fruit harvested from plants amended with three doses of chicken droppings

Mineralelements		Addition of chicken droppings per batch			
		0g	100g	200g	300g
Macroelements (%)	Potassium	1,93	2,46	2,86	2,31
	Phosphorus	0,84	1,22	1,18	1,11
	Sodium	0,003	0,005	0,005	0,004
	Calcium	0,30	0,33	0,40	0,31
	Magnesium	0,24	0,33	0,31	0,29
	Chlorine	0,14	0,19	0,21	0,23
		3,45	4,56	4,83	4,51
Microelements (ppm)	Chromium	15,1	15,5	16,4	13,1
	Sulphur	510	730	750	720
	Silica	316,7	330,7	392,3	201,8
	Iron	70,5	81,7	82,2	79,5
	Zinc	31,2	39	40,5	42,8
	Manganese	19,3	22,9	24,2	20,4
	Copper	17,4	19,6	20,9	18,7
	Bromine	4,9	5,5	5,5	5,5
	Nikel	3,7	3,9	4,5	3,8
	Molybdenum	0,8	1	1,4	1
	Selenium	0,5	0,5	0,5	0,5
	Iodine	27,9	25,4	25,2	25,1
	Tin	43,8	39,1	35,7	36,2
	Cobalt	3,9	3,9	3,9	3,9
	Vanadium	1,3	10,2	2,9	2,3
		580	678	890	680

Occurrence of mineral elements in C4 cultivar fruit fertilised with chicken droppings: The mineral elements in C4 cultivar fruit fertilised with chicken dropping are summarised in Table V. One can see in Table thatfor macroelements, high levels of potassium and phosphorus were observed in the fruits of cultivar C4 (*Solanum macrocarpon* L.) harvested from plants fertilized with chicken droppings. These levels varied according to the doses of chicken droppings applied. Potassium levels of 3.11%, 3.31% and 3.72% were noted in the fruits of plants fertilized with 100, 200 and 300 g of chicken droppings per bunch. In unfertilized plants, the content was 2.80%. A phosphorus content of 1.17% was recorded in the fruit of plants amended with 300 g of chicken droppings. With this dose, calcium, magnesium and chlorine contents of 0.37%, 0.42% and 0.37% were recorded.

An improvement in macro-element content was noted after the addition of chicken droppings. The contents of 5.29%, 6.34% and 6.12% on the fruits of plants amended with 100, 200 and 300 g of chicken droppings. These levels were higher than 4.7% recorded in the control plants. Also, the addition of chicken droppings improved the micronutrient content of fruits of cultivar C4 (Solanum macrocarpon L) harvested from plants amended with three doses of chicken droppings. Micronutrient levels increased with increasing doses of chicken droppings. Microelement contents of 820, 870 and 910 ppm were recorded in the fruits of plants fertilised with 100, 200 and 300 g of chicken droppings. These levels were higher compared with 760 ppm in the control plants. For these microelements, sulphur, silica, iron and zinc were predominant. Sulphur levels of 730, 770 and 850 ppm were observed in the fruits of plants amended with 100, 200 and 300 g of chicken droppings. These levels were higher at 700 ppm for the control plants (see Table V).

Table V. Mineral element content of fruits of cultivar C4 (*Solanum macrocarpon* L) harvested from plants amended with three doses of chicken droppings

Mineral elements		Addition of chicken droppings per batch			
		0 g	100 g	200 g	300 g
Macroelements (%)	Potassium	2,80	3,11	3,31	3,72
	Phosphorus	1,04	1,08	1,07	1,06
	Sodium	0,06	0,06	0,05	0,04
	Calcium	0,23	0,41	0,37	0,36
	Magnesium	0,34	0,38	0,42	0,36
	Chlorine	0,23	0,25	0,37	0,19
		4,7	5,29	6,34	6,12
Microelements (ppm)	Chromium	15,5	17,7	19,4	22,2
	Sulphur	700	730	770	850
	Silica	412,1	672,5	718,2	394,8
	Iron	69,9	79,2	96,8	83,6
	Zinc	42,9	48,8	46,9	43,7
	Manganese	16,3	18,1	18,9	21,3
	Copper	18,6	23,6	23,9	25
	Bromine	4	4,8	4,9	8,9
	Nikel	3,8	4,5	4,7	4,2
	Molybdenum	0,9	1,2	1,7	1,4
	Selenium	0,5	0,5	0,5	0,5
	Iodine	24,4	26,5	27,9	26,3
	Tin	32,2	33,4	36	36,8
	Cobalt	3,9	3,9	3,9	3,9
	Vanadium	3	3,7	3,9	3,2
		760	820	870	910

DISCUSSION

The study assessed the mineral content of aubergine fruit harvested from plants fertilised with three doses of chicken droppings per packet (FPQ). Chicken droppings (FP) improved the macro- and micro-element content of aubergine fruit. This improvement is due to the mineral elements contained in the chicken droppings. The presence of macro- and micro-elements in chicken droppings has been demonstrated (Holland *et al*., 1991; Lumpungou, 2006; Agoreyo *et al*., 2012). The addition of chicken droppings improved vegetative growth, flower production, flower bloom and fruiting in four local aubergine cultivars (Mpika *et al*., 2022). The mineral elements in chicken droppings are absorbed by the roots and stored in the fruit of local aubergine cultivars. This fruit is thought to be a real sink for the mineral salts provided by chicken droppings. This is reflected in the high micronutrient content of aubergine fruit (Stevels, 1990; Lumpungu, 2006; Schlienger, 2011).

For the four local aubergine cultivars, the addition of 200 g of FPQ increased the mineral salt content in fruit harvested at gustatory maturity. This quantity would be optimal compared with 100 g and 300 g corresponding to deficiency and excess of QPS. The dose effect of this organic amendment has been reported by Agbede *et al* (2008), Mpika *et al* (2022) and Chaillou *et al* (1986). Sou *et al* (2007) found that 300g reduced the mineral content. On the other hand, Tchabi *et al* (2012) observed a clear accumulation in lettuce after 200g of cow dung. With this optimal dose, the fruits of cultivars C3 and C4 proved to be very rich in microelements and macroelements respectively. The C4 cultivar is rich in macroelements and phenolic compounds, making it a health food. It is not widely consumed because of its bitterness, but the infusion and powdered fruit of the C4 cultivar are used in medicinal portions in the Congo (Mbon *et al*., 2023). The fruit of cultivar C3, rich in microelements, is highly prized by Congolese consumers. When 200g of FPQ were added, the fruits of local aubergine cultivars were found to have a high potassium content. This element stood out from phosphorus, sodium, calcium, magnesium and chlorine. The richness of potassium makes eating aubergine fruit essential for good health. Potassium is involved in many vital physiological processes (Echeverri and Roman-Jitdutjaano, 2011). In the body, it regulates water balance and ensures transmission of nerve impulses, muscle contraction (including that of the heart muscle), regulation of blood pressure and maintenance of acid-base balance (Freydier *et al*., 1998; Ward, 1990). According to Stevels (1990), the high levels of potassium in aubergine fruits may be favourable for the use of these fruits in the treatment of hypertension, cardiovascular and renal diseases. In addition to potassium, magnesium and calcium are also important in cellular metabolism. A small amount of sodium has also been reported. Bivalent cations are involved in the functioning of enzymes (ATPases). Phosphorus is a component of nucleic acids (Schlienger, 2011). The presence of calcium, magnesium and phosphorus was mentioned in aubergine fruits (Echeverri& Roman-Jitdutjaano, 2011).

The use of aubergine fruit powders in cooking can therefore be beneficial for humans, who have a great need for them because of the macroelements required for metabolic balance. When 200 g of FPQ was added, a preponderance of sulphur, silicon, iron, zinc, iodine and tin was observed in aubergine fruit. The content of these microelements was higher than in fruit harvested from unfertilised plants. Aubergine plants would preferentially absorb these microelements from soils amended with chicken droppings and accumulate them in their fruit. This preference was proven by (Rogalla&Römheld, 2002; Liang *et al*., 2006 ; Mali & Aery, 2008a). The fruits of the four local cultivars, which are very rich in sulphur and silicon, are thought to accumulate silicon and sulphur. Although silicon stimulates plants' natural defences against pests, it also plays a vital role in the immune system. It is involved in the conversion of B lymphocytes into T lymphocytes (Landrault *et al*., 2002; Liang & Miroslav, 2015). This process enables the body to manufacture antibodies and antigens, the pillars of our immune system. In addition, the importance of sulphur, iron, zinc and iodine for hormones, enzymes and vitamins has been demonstrated (Essatara & TantaouiElaraki, 2021). Zinc is essential for insulin synthesis and protein synthesis, while iodine is a component of thyroid hormones. Thiamine (vitamin B1) contains sulphur, and cobalt is part of vitamin B12 (cobalamins). Iron is involved in the transport of oxygen by haemoglobin in the blood, of which it forms a part. Many enzymes contain minerals (zinc in carbonic anhydrase, molybdenum in xanthine oxidase, etc.) or require them for their functioning (iron and copper for the activity of the cytochrome enzyme system, enzymes necessary for the respiratory process). The microelements essential to the human body are present in the fruit of the four local aubergine cultivars consumed in the Congo. In addition to mineral salts, the fruits of the four aubergine cultivars were drained of water with contents of over 85%. No link was established between fruit water content and FPQ intake. Whatever the FPQ dose, the fruit of cultivar C4 showed a low water content. This fermenting of cultivar fruit would be linked to genetic character.

CONCLUSION

This study revealed the richness in mineral salts of the fruits of local aubergine cultivars harvested from plants fertilised with chicken droppings. The high occurrence of macro and microelements in these fruits was observed on plants amended with 200 g of chicken droppings per bunch. Regular consumption of the fruits of *Solanum aethiopicum* L. (cultivars C1, C2 and C3) and Solanum macrocarpon L (cultivar C4) is necessary because of their high potassium, phosphorus, calcium and magnesium content. These macro-elements are important for toning up and balancing the metabolism of the human body.

Conflict of interest: The authors declare that there is no conflict of interest

Authors' contributions

Attibayeba conceived the research project and corrected the manuscript. Mbon Nguékou Chrichina carried out the project and drafted the manuscript. Etou Ossibi Grace Jokael and Mvoumbi Tété Chanelle Bertille worked in the laboratory. Mpika Joseph analysed the results.

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