

Comparative Analysis of the Effects of Different Types of Liquid Organic Fertilizers on the Nutrient Composition of Maize (*Zea mays*)

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Abstract

Application of Liquid Organic Fertilizers (LOF) produced from rabbit wastes had been found as a good substitute to chemical fertilizers such as NPK for a viable maize production. Maize (*zea mays*) is a staple food with great potentials for enhancing food and nutrition security in Nigeria. We need to evaluate the effects of the organic fertilizers on the nutrients content of maize as a staple crop consumed by majority of people in Nigeria and globally. Maize (Quality protein maize) was planted with the application of LOFs, NPK, and ZERO application control plot. Samples of maize yield were harvested fresh, dried to 10% moisture content, ground into powder and evaluated for proximate, mineral, vitamins and antinutrients content. Correlation analysis showing the relationship of the attributes was also carried out. Results showed that protein content was significantly highest ($p < 0.05$) in maize sample from soil treated with urine from concentrate and forage + fecal from concentrate and forage + banana root + neem (12.64%) (TRT6) while crude fibre was significantly highest ($p < 0.05$) in maize sample from soil treated with urine from rabbits fed with forage + fecal from forage+ Corn cob+ Banana root +Neem (2.01%) (TRT7). Sample TRT 7 recorded the highest magnesium, phosphorous, calcium, zinc and iron and also contained the highest vitamins B1 and B2. Sample TRT10-the control (No LOF, no NPK) recorded the least antinutrients content followed by sample TRT2 (Urine from forage and concentrates only). Fat and protein, protein and ash, ash and crude fibre had strong positive correlation. Application of liquid organic fertilizer from rabbit wastes fed with forage yielded positive effect on the nutritional status of maize. The technology is recommended for application to other crops cultivation for enhanced crop nutrients.

Key words: Organic fertilizer, forage, maize, nutrients, antinutrients

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1. Introduction

Maize (*Zea mays*) grains accounts for about 15 to 56% of the total daily calories in diets of people in about 25 developing countries, particularly in Latin America and Africa, where animal protein is expensive and consequently, unavailable to a vast sector of the population (Vasal 2000). Maize ranks third as a staple food, after wheat and rice. This may probably be due to the cultural or social preferences for maize and also because in some countries, maize is cultivated as livestock feed. Maize is one of the most widely utilized cereals in Nigeria and other West African countries. This is probably because of its high yielding potentials, storability and versatility in processing. Maize kernel, which is the nutritive part of the plant, contains phytochemicals such as carotenoids, phenolic compounds, and phytosterols (Rouf *et al.* 2016). It is rich in macronutrients such as starch, fiber, protein, and fat; it also contains substantial amounts of micronutrients such as vitamin B complex, carotenoids, and estimated minerals, i.e., magnesium, zinc, phosphorus, copper, etc. In Africa, Maize is commonly consumed as immature or matured whole kernel (i.e., boiled or roasted), freshly ground or parched ground into grits and flour for the production of different kinds of traditional and conventional products (Ekpa *et al.* 2019).

Some studies had reported that liquid organic fertilizer (LOF) produced from rabbit urine contains essential nutrients such as nitrogen, phosphorus and potassium, as well as essential microorganisms which can serve as bio-fertilizer for plant growth (Said *et al.* 2018; Widayati *et al.* 2023; Azeez *et al.* 2024). The use of LOF seeks to achieve improve crop yields, livestock productivity, sustainable soil health due to improved soil fertility, enhanced soil structure due to improved soil aggregation, aeration, and water-holding capacity, and increased in soil microbial activity which is essential for nutrient cycling and plant growth (Mamatha *et al.* 2024). The impact of liquid organic fertilizer, specifically made from rabbit wastes, on the growth of maize had been reported to enhance the plant height, leaves number, chlorophyll, and stem diameter with high yield compared favourably well with NPK fertilizer (Azeez *et al.* 2025). Data on the effect of LOF produced from rabbit urine and faeces collected from different feeding types on maize yield fruit content are very scarce.

In this study, rabbit urine and faeces collected from rabbits fed with different diets (forage only, and forage plus concentrate) were subjected to a 21-day fermentation process. The resulting LOF were applied as soil amendment and its impact was evaluated on soil properties and maize production. It was hypothesized that the LOF from rabbit wastes has comparable effects as chemical fertilizers in maize production. Therefore, the objective of this study was to determine whether liquid organic fertilizers produced from rabbit wastes under different feeding regimes can be a viable substitute for chemical fertilizers such as NPK in nutrient contents uptake in maize, while promoting environmental sustainability.

2. Materials and Methods

Quality protein maize (BR9928DMR-SR-Y) seeds were obtained from Institute of Agricultural Research and Training, Moor Plantation, Ibadan. LOF produced from faecal and urine of rabbits fed on different feeding regimes (concentrates alone, concentrates plus forage, forage alone) (Azeez *et al.* 2024) and its incorporation into the soil with the NPK to grow the maize seeds (Azeez *et al.* 2025). The maize yield from different LOF treatments were coded as TRT1 to TRT8 respectively while NPK and soil without treatments were coded as TRT9 and TRT10 respectively as control. The maize was harvested in August 2024, three months after planting and were dried to 10% moisture level. The dried maize samples were subjected to chemical analysis using AOAC (2005) method for determination of proximate composition, minerals, vitamins and anti-nutrients content. Data obtained were evaluated using descriptive and inferential statistics. Significance was accepted at 5% level.

3. Results and Discussions

3.1 Proximate composition

Fat content in the samples ranged between 1.93% in the control (soil without any fertilizer) to 3.52% in samples TRT5 (Urine from forage +Fecal from forage + banana root +Neem). Protein content was significantly highest ($p<0.05$) in maize sample from soil treated with urine from concentrate and forage +fecal from concentrate and forage + banana root +neem (12.64%) (TRT6) while crude fibre was significantly highest ($p<0.05$) in maize sample from soil treated with urine from forage +Fecal from forage+ Corn cob+ Banana root +Neem (2.01%) (TRT7) respectively. These findings confirmed increase in protein, fat and crude fibre content of maize produced from liquid organic fertilizer treated soil compared with that of the control as reported by Toishimanov *et al.* (2024). Ksiezak & Bojarszczuk (2022) and Efthimiadou *et al.*, (2022) similarly reported increase in protein and fat content of maize and soybean grains produced from organic fertilizer treated soil compared with maize produced from no-fertilized soil. Values of protein and fat content reported by Efthimiadou *et al.* (2022) ranging between 6.39% and 6.71% protein and 2.93% and 3.0% fat content respectively were lower than the values of protein and fat content for all the samples reported in this study. Abubakar *et al* (2016) reported corn cobs and banana leaves as good source of protein and fibre. Similarly, the report of Osho *et al.* (2021) showed that neem leaves contain 24% protein, 13% crude fibre and 8% fat. It can be fathomed from this study that these nutrients content of corn cob, banana leaves and neem in coupled with the nutrient contents of the urine and fecal matter of rabbit as the composition of the liquid organic fertilizer used in this study, might have contributed to the enhanced nutrients content of the maize samples produced from fertilized soil compared with the control. The control (maize from untreated soil) (TRT10) was significantly low ($P<0.05$) in protein, fat, ash and crude fibre content (Table1).

3.2 Minerals

There was no significant difference ($p<0.05$) in the magnesium and phosphorous contents of TRT7 (maize from soil treated with urine from forage +fecal from forage+ Corn cob+ Banana root +Neem) and TRT9 (maize from soil treated with NPK) (Table 2). There was also no significant difference ($p<0.05$) in the potassium content of samples TRT6 (maize from soil treated with urine from concentrate and forage +fecal from concentrate and forage + banana root +Neem) and TRT8 (maize from soil treated with urine from concentrate +fecal from concentrate+ Corn cob+ Banana root +Neem). Sample TRT 7 recorded the highest magnesium, phosphorous, calcium, zinc and iron (354.76, 788.35, 283.80, 1.55 and 1.63 mg/100g respectively) (Table 2). High mineral content in TRT 7 might be as a result of the presence of corn cob, banana leave and neem in the composition of the fertilizer used for producing the maize sample. Abubakar *et al.* (2016) reported that corn cob and banana leaves were rich in minerals. Osho *et al.* (2021) similarly reported neem as very good source of minerals particularly phosphorous and calcium.

Table 1. Proximate Composition of the Maize Samples (%)

Sample	Fat	Protein	Ash	Moisture	Crude fibre	Carbohydrate	Energy
TRT1	2.0367 [±] 0.013 ^f	9.1700 ± 0.023 ^f	1.6000 ± 0 ^f	9.4367 0.009 ^d	± 1.0633 0.007 ^g	± 76.6867 0.035 ^b	± 365.4733 0.111 ^e
TRT2	2.4567 0.003 ^e	± 10.4567 0.019 ^e	± 1.6000 ± 0 ^f	9.6767 0.082 ^{ab}	± 0.9633 0.003 ^h	± 74.85 ± 0.095 ^d	± 366.9267 0.313 ^{cd}
TRT3	2.6567 0.003 ^d	± 8.8733 0.078 ^{fg}	± 1.4400 0.015 ^g	± 9.7267 0.015 ^a	± 1.1967 0.003 ^c	± 76.1067 0.074 ^c	± 367.3667 0.055 ^c
TRT4	2.5067 0.007 ^e	± 10.3500 ± 0.31 ^e	1.8733 0.013 ^e	± 9.5067 0.013 ^{cd}	± 1.1067 0.003 ^f	± 74.6567 0.308 ^d	± 366.1633 0.038 ^{de}
TRT5	3.5267 0.015 ^a	± 12.2633 0.019 ^b	± 2.6867 0.013 ^d	± 8.3633 0.017 ^g	± 1.4167 0.003 ^c	± 71.7433 0.012 ^f	± 371.0967 0.115 ^b
TRT6	2.9167 0.009 ^c	± 12.6400 0.015 ^a	± 2.8367 0.007 ^c	± 9.6100 ± 0 ^b	1.2200 ± 0 ^d	70.7733 0.022 ^g	± 363.3267 0.066 ^f
TRT7	2.6500 0.01 ^d	± 11.0967 0.026 ^d	± 3.1267 0.003 ^b	± 9.5800 0.03 ^{bc}	± 2.0133 0.003 ^a	± 71.5300 0.029 ^f	± 357.7967 0.145 ^g
TRT8	2.5333 0.033 ^e	± 11.7267 0.234 ^c	± 3.2667 0.007 ^a	± 9.1533 0.027 ^e	± 1.9800 ± 0 ^b	71.3367 0.234 ^f	± 358.5267 0.283 ^g
TRT9	3.1333 ± 0.07 b	± 11.9533 0.026 ^{bc}	± 1.5733 0.013 ^f	± 8.8367 0.003 ^f	± 0.9567 0.003 ^h	± 73.5467 0.074 ^c	± 373.6767 0.299 ^a
TRT10	1.9333 [±] 0.088 ^f	8.6967 ± 0.026 ^g	1.1233 0.018 ^h	± 9.6733 0.032 ^{ab}	± 0.8667 ⁱ 0.003	± 77.7100 0.042 ^a	± 366.7633 0.616 ^{cd}
Fcal	161.69*	130.37*	5206.26*	195.5*	13723.9*	352.65*	344.68*

Means with same superscript within column are not significantly different (p<0.05)

Key: TRT1=Urine from forage only TRT2=Urine from forage and concentrates only

TRT3=Fecal from forage only

TRT4=Fecal from forage and concentrates only

TRT5=Urine from forage +Fecal from forage = banana root +Neem

TRT6= Urine from concentrate and forage +fecal from concentrate and forage + banana root +Neem

TRT7= Urine from forage +Fecal from forage+ Corn cob+ Banana root +Neem

TRT8= Urine from concentrate +Fecal from concentrate+ Corn cob+ Banana root +Neem

TRT9=NPK

TRT10= Control (No LOF, No NPK)

Table 2. Mineral Content of the Maize Samples (mg/100g)

Sample	Magnesium	Potassium	Phosphorous	Calcium	Zinc	Iron
TRT1	158.611 ± 0.465 ⁱ 216.566 ±	393832 ± 0.283 ^g	415.626 ± 0.000 ^h	149.625 ± 0.020 ^h	0.8075 ± 0.008 ⁱ	3.7682 ± 0.007 ^{de}
TRT2	0.465 ^g	485.883 ± 0.000 ^e	514.591 ± 1.035 ^g	158.216 ± 0.874 ^g	1.0643 ± 0.002 ^g	3.5468 ± 0.226 ^e
TRT3	242.941 ± 0.000 ^f 298.385 ±	596.770 ± 0.931 ^d	538.203 ± 1.666 ^f	194.353 ± 0.020 ^f	0.8209 ± 0.000 ^h	4.3646 ± 0.007 ^b
TRT4	0.465 ^d 303.510 ±	607.020 ± 0.931 ^c	565.601 ± 2.333 ^c	238.708 ± 0.372 ^c	1.3097 ± 0.002 ^c	4.6492 ± 0.007 ^a
TRT5	0.465 ^c 262.142 ±	417.222 ± 0.938 ^f	677.800 ± 1.154 ^c	242.808 ± 0.372 ^d	1.3729 ± 0.006 ^d	3.6711 ± 0.003 ^e
TRT6	0.350 ^e 354.761 ±	709.521 ± 0.000 ^a	663.078 ± 1.035 ^d	0.296 ^c	1.4188 ± 0.007 ^c	4.6357 ± 0.008 ^a
TRT7	0.000 ^a 340.783 ±	681.567 ± 0.000 ^b	788.357 ± 0.000 ^a	283.809 ± 0.000 ^a	1.5572 ± 0.020 ^a	4.6357 ± 0.008 ^a
TRT8	0.000 ^b 350.557 ±	711.321 ± 0.001 ^a	757.296 ± 0.000 ^b	281.441 ± 1.856 ^a	1.458 ± 0.00 ^b	4.0122 ± 0.007 ^c
TRT9	0.003 ^a 187.032 ±	596.520 ± 0.931 ^d	788.357 ± 0.000 ^a	272.627 ± 0.010 ^b	1.0914 ± 0.001 ^f	3.9308 ± 0.007 ^{cd}
TRT10	0.000 ^h	374.064 ± 0.002 ^h	352.469 ± 1.035 ⁱ	126.889 ± 0.372 ⁱ	0.6962 ± 0.002 ^j	3.7004 ± 0.006 ^e
Fcal	2151.38*	1891.33*	2484.16*	1894.28*	10858.6*	37.5*

Means with same superscript within column are not significantly different (p<0.05)

Key:

TRT1=Urine from forage only
TRT2=Urine from forage and concentrates only
TRT3=Fecal from forage only
TRT4=Fecal from forage and concentrates only
TRT5=Urine from forage +Fecal from forage = banana root +Neem
TRT6= Urine from concentrate and forage +fecal from concentrate and forage + banana root +Neem
TRT7= Urine from forage +Fecal from forage+ Corn cob+ Banana root +Neem
TRT8= Urine from concentrate +Fecal from concentrate+ Corn cob+ Banana root +Neem
TRT9=NPK
TRT10= Control (No LOF, No NPK)

3.3 Vitamins

Sample TRT7 (maize from soil treated with urine from forage +fecal from forage+ Corn cob+ Banana root +Neem) contained the highest vitamins B1 and B2 while sample TRT8 (maize from soil treated with urine from concentrate +fecal from concentrate+ Corn cob+ Banana root +Neem) recorded the highest vitamin C content. The least vitamin B2 and vitamin C contents were recorded in sample TRT1 (maize from soil treated with urine from forage only) (Table 3). Addition of corn cob, banana root and neem to the liquid fertilizer applied to the soil must have enhanced the vitamin content of the maize. Banana leaves and neem leaves have been reported to be high in vitamin B complex and vitamin C (Osho *et al.* 2021). The implication of this finding is that the addition of banana root/leaves and neem leaves to rabbit wastes during fermentation process for LOF production would enhance the quality of the LOF and food produce from its' application

3.4 Anti-nutrients

Table 4 presents the anti-nutrients content in the maize samples. Samples TRT3,4,5,6,7 and 8 were significantly high in tannin (1.120,1.070, 1.159, 0.898, 0.897 and 1.366 mg/100g respectively) with sample TRT8 (Urine from concentrate +Fecal from concentrate+ Corn cob+ Banana root +Neem treated sample) recording the highest tannin content. This might probably be as a result of plant materials (corn cob and neem especially) used as catalysts during fermentation process and as part of the fertilizer. Corn cob and neem have been reported to contain tannin (Ukanwoko & Nwachukwu, 2017). Sample TRT 8 also recorded the highest phytate and oxalate. There was no significant difference in the phytate contents of sample TRT6 (maize from soil treated with urine from concentrate and forage +fecal from concentrate and forage + banana root +Neem) and sample TRT9 (maize from NPK treated soil). Sample TRT10 (The control- No LOF, No NPK) contained the least anti-nutrients (tannin, phytate, saponin and oxalate). The antinutrients values recorded in this study are within the minimum permissible recommended in foods. The implication of these findings is that addition of corn cobs, banana roots and neem leaves acted as fundamental catalysts in the fermentation process for LOFs production, enhanced the mineral contents, and vitamins, and at the same time, fermentation reduced the anti-nutrients contents like tannin, phytate, saponin and oxalate to minimum quantity within the approved standard level for consumption.

Table 3. Vitamin content of the Maize Samples

Sample	Vitamin B1	VitaminB6	Vitamin C
TRT1	0.6474 ± 0.001 ^c	1.0431 ± 0.003 ^d	3.0675 ± 0.065 ^d
TRT2	0.6415 ± 0.002 ^d	1.0527 ± 0.002 ^c	3.2708 ± 0.098 ^{cd}
TRT3	0.6533 ± 0.001 ^{ab}	1.0623 ± 0.001 ^{ab}	3.3208 ± 0.011 ^{cd}
TRT4	0.6522 ± 0.001 ^b	1.0605 ± 0.001 ^b	3.6667 ± 0.218 ^b
TRT5	0.6541 ± 0.001 ^{ab}	1.0635 ± 0.002 ^{ab}	3.5333 ± 0.023 ^{bc}
TRT6	0.6437 ± 0.00 ^{cd}	1.0467 ± 0.001 ^{cd}	3.3000 ± 0.131 ^{cd}
TRT7	0.6563 ± 0.001 ^a	1.0671 ± 0.002 ^a	3.7458 ± 0.015 ^{ab}
TRT8	0.6474 ± 0.002 ^c	1.0527 ± 0.003 ^c	3.9958 ± 0.04 ^a
TRT9	0.6444 ± 0.002 ^{cd}	1.0479 ± 0.003 ^{cd}	3.5417 ± 0.065 ^{bc}
TRT10	0.6463 ± 0.001 ^c	1.0509 ± 0.002 ^c	3.1125 ± 0.006 ^d
Fcal	16.25*	16.25*	10.16*

Means with same superscript within column are not significantly different (p<0.05)

Key:

TRT1=Urine from forage only

TRT2=Urine from forage and concentrates only

TRT3=Fecal from forage only

TRT4=Fecal from forage and concentrates only

TRT5=Urine from forage +Fecal from forage = banana root +Neem

TRT6= Urine from concentrate and forage +fecal from concentrate and forage + banana root +Neem

TRT7= Urine from forage +Fecal from forage+ Corn cob+ Banana root +Neem

TRT8= Urine from concentrate +Fecal from concentrate+ Corn cob+ Banana root +Neem

TRT9=NPK

TRT10= Control (No LOF, No NPK)

Table 4. Anti-nutrients content of the maize samples ((mg/100g)

Sample	Tannin	Phytate	Saponin	Oxalate
TRT1	0.827 ± 0.0039 ^{cd}	0.141 ± 0.0021 ^e	0.182 ± 0.0031 ^d	0.093 ± 0.0003 ^{de}
TRT2	0.79 ± 0.001 ^d	0.145 ± 0.0007 ^e	0.239 ± 0.0018 ^a	0.088 ± 0.0000 ^g
TRT3	1.120 ± 0.0024 ^b	0.155 ± 0.0012 ^d	0.209 ± 0.0057 ^b	0.092 ± 0.0000 ^c
TRT4	1.070 ± 0.0085 ^b	0.184 ± 0.0012 ^c	0.239 ± 0.0064 ^a	0.095 ± 0.0003 ^c
TRT5	1.159 ± 0.0094 ^b	0.154 ± 0.0043 ^d	0.243 ± 0.0037 ^a	0.091 ± 0.0003 ^f
TRT6	0.898 ± 0.0029 ^c	0.191 ± 0.0034 ^b	0.197 ± 0.0013 ^c	0.083 ± 0.0003 ^h
TRT7	0.897 ± 0.0127 ^b	0.234 ± 0.0018 ^a	0.209 ± 0.0018 ^b	0.093 ± 0.000 ^{cd}
TRT8	1.366 ± 0.0918 ^a	0.235 ± 0.0012 ^a	0.207 ± 0.0013 ^b	0.109 ± 0.0003 ^a
TRT9	0.815 ± 0.001 ^{cd}	0.192 ± 0.0009 ^b	0.248 ± 0.0038 ^a	0.103 ± 0.0000 ^b
TRT10	0.634 ± 0.001 ^e	0.112 ± 0.004 ^f	0.175 ± 0.0024 ^d	0.083 ± 0.0000 ^h
Fcal	53.49*	275.82*	54.45*	1140.98*

Means with same superscript within column are not significantly different (p<0.05)

Key:

TRT1=Urine from forage only

TRT2=Urine from forage and concentrates only

TRT3=Fecal from forage only

TRT4=Fecal from forage and concentrates only

TRT5=Urine from forage +Fecal from forage = banana root +Neem

TRT6= Urine from concentrate and forage +fecal from concentrate and forage + banana root +Neem

TRT7= Urine from forage +Fecal from forage+ Corn cob+ Banana root +Neem

TRT8= Urine from concentrate +Fecal from concentrate+ Corn cob+ Banana root +Neem

TRT9=NPK

TRT10= Control (No LOF, No NPK)

3.5 Correlation relationship of attributes of the maize samples

The correlation relationships between the attributes of the maize samples are presented in Tables 5 to 8.

3.5.1 Proximate Correlation

Fat and protein, protein and ash, ash and crude fibre have strong positive correlation. Crude fibre has negative correlation with energy and also with carbohydrate Table 5. This shows that Fat and protein, protein and ash, ash and crude fibre have positive impact on one another respectively. It means samples with high protein also have high fat content. Similarly, samples with high protein also have high ash content. Ash and crude fibre also had similar trend. On the other hand, crude fibre and carbohydrate have negative relationship, when carbohydrate is high, crude fibre tend to be low. Crude fibre and energy had similar trend of negative impact. In this study, crude fibre and energy had strong negative correlation, samples with high crude fibre had low energy content. In this study also carbohydrate and energy are weakly and positively correlated, so samples with high carbohydrate had slightly high energy.

The study shows that magnesium had strong positive correlation with potassium, phosphorous, calcium and zinc while it had weak positive correlation with iron (Table 6). Potassium also had strong positive correlation with phosphorous, calcium, zinc and iron. Calcium had moderate positive correlation with iron while zinc had weak

positive correlation with iron. The result shows that samples with high magnesium also contain high potassium, phosphorous, calcium and zinc. Similarly, samples that are high in calcium tend to be high in zinc. Zinc and iron on the other hand had slightly positive impact on one another.

3.5.2 Vitamin correlation

Vitamin B1 and B6 had a very strong positive correlation while Vitamin C showed a weak positive correlation with vitamin B1 and B6 (Table 7). This shows that samples that are high in vitamin C tend to have slightly high vitamin B1 and B6 but may be inconsistent

3.5.3 Anti-nutrients correlation

Oxalate with Tannin and Phytate are positively correlated, this means that the samples that are high in tannin and phytate tend to contain more oxalate.

Table 5. Proximate Correlation

	Fat	Protein	Ash	Moisture	Crude Fibre	Carbohydrate	Energy
Fat	1						
Protein	0.77*	1					
Ash	0.43*	0.72*	1				
Moisture	-0.72*	-0.58*	-0.29	1			
Crude Fibre	0.22	0.4*	0.88*	-0.16	1		
Carbohydrate	-0.68*	-0.92*	-0.91*	0.42*	-0.69*	1	
Energy	0.38*	-0.03	-0.63*	-0.46*	-0.74*	0.35	1

Table 6. Minerals Correlation

	Magnesium	Potassium	phosphorus	calcium	Zinc	Iron
Magnesium	1					
Potassium	0.69*	1				
phosphorus	0.94*	0.73*	1			
calcium	0.93*	0.8*	0.96*	1		
Zinc	0.79*	0.69*	0.81*	0.87*	1	
Iron	0.41*	0.74*	0.36*	0.55*	0.47*	1

Table 7. Vitamins correlation

	Vitamin B1	Vitamin B6	Vitamin C
Vitamin B1	1		
Vitamin B6	0.85*	1	
Vitamin C	0.30	0.38*	1

Table 8. Anti-nutrients correlation

	Tannin	Phytate	Saponin	Oxalate
Tannin	1			
Phytate	0.27	1		
Saponin	0.08	0.07	1	
Oxalate	0.53*	0.50*	0.33	1

4. Conclusions

Liquid Organic Fertilizers made from urine and fecal of rabbits fed on forage and concentrates improve the soil organic matter which improved the nutrients uptake by the plant and subsequently improved the nutrients content of the maize grains.

Maize grains produced with the application of liquid organic fertilizers produced from rabbit wastes with addition of corn cobs, banana roots/leave and neem leaves contain high protein, fat, and crude fibre contents, high in mineral contents such as magnesium, phosphorous, potassium, calcium, zinc, and iron at the same time rich in vitamin such as B₁, B₆ and C. The maize also contains minimal level of anti-nutrients such as tannin, phytate, saponin and oxalate within the approved standard for consumption.

The maize grains also contain high protein, fat and crude fibre with strong positive correlation between the protein and fat content, magnesium, phosphorous, potassium, calcium and zinc content as well as between vitamin B₁ and B₆ of the maize samples

Soil treated with urine from forage + fecal from forage + Corn cob + Banana root + Neem depicts enhanced nutritional effect on the maize samples, having high contents in protein, fat, and it is therefore recommended as best organic fertilizer for production of nutritious maize.

The addition of corn cobs, banana roots and neem leaves acted as fundamental catalysts in the fermentation process for LOFs production, enhanced protein, fat, crude fibre, minerals and vitamins contents, with reduced anti-nutrients like tannin, phytate, saponin and oxalate at minimum quantity within the approved standard level for consumption.

Based on the conclusions, the adoption of the Liquid Organic Fertilizer (LOF) derived from forage-fed rabbit urine and feces combined with corn cobs, banana roots, and neem leaves through integrated training for maize farmers by agricultural extension agents would enhance sustainable maize food production and nutrition security.

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