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EFFECT OF MAGNETICALLY TREATED WATER ON THE QUALITY OF TOMATO

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ABSTRACT
This study was conducted to determine the effect of magnetically treated water on the quality of tomato. The values of magnetic flux densities used for treating the irrigation water were 124, 319 and 719 G produced from electromagnet with direct current. The tomato (variety UC82B) was planted in 28 buckets in a transparent garden shed for 130 days and irrigated with magnetically treated water and non–magnetically treated water. The mean values of vitamin A and vitamin C were higher with the tomato irrigated with magnetically treated water than tomato irrigated with non – magnetically treated water. The lead was slightly higher with tomato irrigated with magnetically treated water than the non–magnetically treated water. The values of vitamin A with water treated by 124 G, 319 G and 719 G were 0.68mg/kg, 0.74 mg/kg and 0.80 mg/kg, respectively while vitamin A for non-magnetically treated water was 0.73 mg/kg. The values of vitamin C with water treated by 124 G, 319 G and 719 G were 117.30 mg/kg, 114.03 mg/kg and 115.10 mg/kg, respectively while vitamin C for non-magnetically treated water was 113.93 mg/kg. The value of lead was 0.083, 0.090 and 0.083 mg/kg for magnetically treated water while that of non-magnetically treated water was 0.07 but WHO Standards (permissible limits) for lead in tomato is 0.1 mg/kg.

Keywords: Magnetic treatment of water, Magnetized water, Tomato quality irrigated with magnetic water, Crop booster, Tomato.

INTRODUCTION
Magnetic treatment of water is a non–chemical method and a new technology for agriculture that boosts crop yield [1]. It also improves crop quality, increased minerals dissolvability of water and enhances nutrients uptake of crops [2, 3, 4, 5, 6]. The effective magnetic induction for water treatment ranging from 0.1 to 0.6 T (Tesla) but 0.4 to 0.5 T can attain the efficiency of 60 to 80% when applied on heater and low – pressure boilers [7]. A permanent magnet with magnetic field strength of 0.55 T for treating water which was used to irrigate lady's finger moench plant and the effect on plant growth and the yield was significant [8]. Magnetically treated water increases dissolvability of water for macro and micro elements in the soil [5]. The uptake of some elements such as nitrogen, calcium and sulphur by tomato may improve the quality of tomato but when an element like lead which can cause cancer is presence in excess may affect the quality of tomato [9].

MATERIALS & METHODS
Magnetic flux densities used for the treatment of irrigation water in this study were 124, 319 and 719 G produced from the electromagnet. The north and south poles of the electromagnetic cores on the treatment chamber seat in this study were alternated for effective treatment of irrigation water by the magnetic field [10]. The irrigation water was allowed to pass through three treatment chamber units four (4) times for duration of 113 s in the chamber. When water passes through the magnetic field, its structure and some physical characteristic such as density, salt solution capacity, and deposition ratio of solid particles will be changed [11]. Moussa concluded that magnetized water with 3000 G could

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improve quantity and quality of common bean crop [12]. He pointed that magnetic water could stimulate defense system, photosynthetic activity, and translocation efficiency of photoassimilates in common bean plants. Three samples of tomatoes were harvested after 130 days from each tomato irrigated with magnetic water treated with 124, 319 and 719 G and the quality of tomato (vitamin A, vitamin B and lead) was analyzed. The quality of tomato irrigated with non–magnetically treated water was also analyzed.

Statistical analysis of quality of tomato by paired t – test

Statistical analysis of the quality of tomato was determined using paired t – test method to check if the effect of magnetic treatment of water was statistically significant on the quality (vitamin A, vitamin C and lead contents) of tomato. The difference between the two mean of the results was determined which was used to compute the standard deviation, standard error and t – test value using Equations (1), (2a) or (2b), (3) and (4), respectively as given by [13].

$$\bar{d} = \frac{\sum d}{n} \quad (1)$$

$$\delta = \sqrt{\frac{\sum \left(d - \bar{d}\right)^2}{n-1}} \quad (2a)$$

$$\delta = \sqrt{\frac{\sum d^2 - n\left(\bar{d}\right)^2}{n-1}} \quad (2b)$$

$$\delta_{Er} = \frac{\delta}{\sqrt{n}} \quad (3)$$

$$t_{cal} = \frac{\bar{d}}{\delta_{Er}} \quad (4)$$

where $\bar{d}$ is the mean of the difference from the data x_1 and x_2, Σd is the summation of d, n is the number of the treatments (observations), δ is the standard deviation, δ_{Er} is the standard error and t_{cal} is the calculated value of t which was compared with the Table value of t_{Tab} at $\alpha = 5$ % significant level but 2.5 % ($\alpha = 0.05/2 = 0.025$) for paired t-test.

RESULTS & DISCUSSION

The quality of tomato was determined based on the percentage content of vitamins A and C present in the tomatoes irrigated with magnetic water and non–magnetic water. The negative effect of magnetic treatment of water was assessed (determined) based on the presence of lead that can cause cancer to man after a prolong period of consumption. The values of vitamin A, vitamin C and lead were shown in Tables 1 and 2. The mean values of vitamin A and vitamin C in Table 2 from Table 1 were higher with the tomato irrigated with magnetically treated water than tomato irrigated with non–magnetically treated water but not statistically significant as shown in the ANOVA Table 3. This means that the tomato produced with magnetically treated water has higher nutritional value than the tomato from non–magnetically treated water.

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The lead was slightly higher with tomato irrigated with magnetically treated water than the non–magnetically treated water but concentration of lead in the tomato was statistically significant with calculated value of t-test was 6.569 while Table value of t-test was 4.303 at α equal to 0.05 (α = 0.05/2, α = 0.025). Magnetically treated water increased dissolvability of the water for plant minerals and increased nutrients uptake by plant as pointed by [5, 14]. The value of lead in the tomato irrigated with magnetically treated water varied from 0.083 – 0.090 mg/kg while the value of lead in the tomato irrigated with non – magnetically treated water was 0.07 m/kg. The values of lead (Pb^{2+}) in the tomatoes irrigated with both magnetically and non – magnetically treated water was less than the permissible limits as given by FAO/WHO 2011 (0.1 mg/kg) for fruit vegetables (tomato) as shown in Table 2. The value of lead in the tomato irrigated with magnetically treated water was higher than the value from non–magnetically treated water but the tomato was okay for consumption without causing cancer to man because the value was less than permissible limits.

Table 1. Tomato quality based on vitamins A and C, and Lead concentration.

Treatment	**Vitamins (mg/kg)**		**Lead (mg/kg)**	**Vitamins (mg/kg)**		**Lead (mg/kg)**	**Vitamins (mg/kg)**		**Lead (mg/kg)**
	A	**C**	**Pb^{2+}**	**A**	**C**	**Pb^{2+}**	**A**	**C**	**Pb^{2+}**
	Sample 1			**Sample 2**			**Sample 3**		
T_1	0.82	120.4	0.09	0.80	116.2	0.10	0.81	114.4	0.08
	0.79	121.6	0.08	0.82	112.4	0.09	0.70	112.6	0.07
	0.80	118.5	0.08	0.84	110.2	0.09	0.82	110.6	0.08
Mean	**0.80**	**120.2**	**0.08**	**0.82**	**112.6**	**0.09**	**0.78**	**112.5**	**0.08**
T_2	0.72	117.2	0.07	0.80	118.4	0.08	0.68	112.4	0.09
	0.80	114.6	0.09	0.76	110.6	0.10	0.62	112.3	0.09
	0.68	118.8	0.10	0.81	111.2	0.10	0.80	111.4	0.10
Mean	**0.73**	**116,7**	**0.09**	**0.79**	**113.4**	**0.09**	**0.70**	**112.0**	**0.09**
T_3	0.69	112.6	0.09	0.69	116.4	0.10	0.59	116.3	0.08
	0.75	110.8	0.08	0.68	121.2	0.09	0.67	121.6	0.09
	0.69	116.4	0.06	0.69	120.4	0.08	0.66	120.0	0.08
Mean	**0.71**	**113.3**	**0.08**	**0.69**	**119.3**	**0.09**	**0.64**	**119.3**	**0.08**
T_c	0.69	112.6	0.06	0.75	116.5	0.07	0.68	116.4	0.07
	0.80	115.6	0.07	0.81	111.8	0.08	0.63	110.9	0.08
	0.75	116.4	0.08	0.80	112.4	0.07	0.64	112.5	0.06
Mean	**0.75**	**114.9**	**0.07**	**0.79**	**113.6**	**0.07**	**0.65**	**113.3**	**0.07**

T_1 = Tomato from magnetic water treated with 719 G, T_2 = 443 G, T_3 = 124 G and T_c = 0 G (tomato from non – magnetically treated water).

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Table 2. Mean values of vitamin A, vitamin C and Lead in the tomato.

Treatment	Vitamins (mg/kg)		Heavy metal (mg/kg)
	A	C	Pb^{2+}
T_1	0.800	115.10	0.083
T_2	0.740	114.03	0.090
T_3	0.680	117.30	0.083
T_c	0.730	113.93	0.070
FAO 2011/WHO 2011			0.1

Table 3. ANOVA for the tomato quality irrigated with magnetically and non-magnetically treated water

Parameter	Degree of freedom	t_{Cal}	t_{Tab} at $\alpha = 0.05$ ($\alpha/2 = 0.025$)	Effect
Vitamin A	2	0.289	4.303	Not significant
Vitamin C	2	1.615	4.303	Not significant
Lead	2	6.569	4.303	Significant

CONCLUSION

Magnetic treatment of irrigation water has effect on the quality of tomato by increasing the vitamin A and vitamin C contents and it did not add lead to the tomato.

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