Correlation between the prevalence of *E.coli* O157:H7 and the physic -chemical characteristics of the soil on a dairy farm reared under field conditions in Baghdad province

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Summary

This study was designed to investigate the correlation of various stress factors (PH, moisture contents, temp., and soil texture) on the ability of *E.coli* OI57:H7 to persist on/in soil on a dairy farm reared under field conditions at the college of Agriculture /University of Bagdad. The prevalence of *E. coli* O157:H7 in soil samples was determined for the period January to June 2012. The surface kinetics of *E.coli* O157:H7 onto the soil (surface kinetics), were theoretically achieved by dividing the farm into 3 zones starting from the fens (Z1),5m, and 10 m (Z5, and Z10, respectively) from the farm in three direction (right, left and rear of the farm) . While the depth kinetics were achieved by taking soil samples from the surface (D0), and at depths of 5, and 10 cm (D5, and D10 respectively) from each zone in the three directions. Nine soil samples (200g) were collected in plastic bags for each distance of 1, 5, and 10m from the farm for each depth of zero (surface), 5 and 10 cm at weekly basis. Sub sample (100g) was made for physicochemical assays. The other subsample was analyzed for *E. coli* OI57:H7. In conclusion, the physico-chemical characteristics of the soil examined, PH, moisture %, sand%, and clay % showed either no consistent or weak correlations with the prevalence of *E.coli* O157:H7 at the dairy farm reared under field conditions. The prevalence of E. coli O157:H7 found in this study are far greater than what would likely be found on a dairy farm in other countries; this is a critically important fact considering that, under natural conditions, even a low level of contamination of *E. coli* O157:H7 with a low infective dose could present a human health hazard.

Keywords: *E.coli* OI57:H7, Stress factors, PH, Moisture contents, Temperature, Soil texture.

Introduction

Escherichia coli O157:H7 is a major public health concern. It is associated with human illnesses ranging from uncomplicated watery diarrhoea to haemorrhagic colitis and hemolytic-uraemic syndrome, which may result in death (1and 2). Cattle are regarded as the major reservoir of *E.coli* O157:H7 linked to human infection (3). Cattle can shed the *E.coli* O157:H7 into environment by means of feces (2). Shiga toxin-producing *E. coli* (STEC) can survive in feces, soil and water (4). Further, (5) indicated that animal feces and irrigation water are the main avenues for the spread of human pathogens to field and the crops growing there. Soil is contaminated due to direct shedding of *E. coli* (STEC) onto pasture land by animals, especially cattle and sheep (4). Survival of *E.coli* O157:H7 in different conditions can be influenced by various factors such as temperature, moisture content, pH, and nutrition. A significant amount of work has been done to elucidate the physical, chemical, and biological factors that control the transport and survival of pathogenic microorganisms (6 - 12). The vast majority of these researches have been conducted in small-scale laboratory experiment. This study was designed to investigate the correlation of various stress factors (PH, moisture contents and soil texture) on the ability of *E.coli* OI57:H7 to persist on/in soil in a dairy farm reared under natural conditions.

Materials and Methods

The farm studied is situated in the College of Agriculture /University of Bagdad. The herd comprised 83 Holstein-Friesian cows aged from 2 to 5 years and calves at different age of rearing. The prevalence of *E. coli* O157:H7 in soil samples it was determined between January through June 2012.

The surface kinetics of *E.coli* O157:H7 onto the soil (surface kinetics), were theoretically achieved by dividing the farm into 3 zones starting from the fens (Z1), 5m, and 10 m (Z5 and Z10, respectively) from the farm . While the depth kinetics were achieved by taking soil samples from the surface (D0), and at depths of 5, and 10 cm (D5 and D10 respectively) from each zone in all directions.

Nine soil samples 200g were collected in plastic bags for each distance of 1, 5, and 10m from the farm for each depth of zero (surface), 5 and 10 cm at weekly basis. Sub sample 100g was made and sent to the Department of Soil at the College of Agriculture for physicochemical assays. The other subsample was kept at 4°C with ice during transportation to the College of Veterinary Medicine /Department of Veterinary Public Health for microbiological analysis.

Colonies of *E.coli* isolated from soil, samples with morphological characteristic of *E.coli* O157: H7 on CT-SMAC, CHRO Magar, and nutrient agar were further confirmed as O157: H7 on EMB agar and biochemical reaction, and subjected to agglutination reaction to identifying the O157 somatic and H7 flagellar antigen.

Statistical analysis was performed using the computer software by David S. Walonick, Ph.D. (Copyright © 1996-2010, Stat Pac Inc.) Two sample t-test between percents with a 5% significance level was used to compare the prevalence of *E.Coli* O157:H7 in soil at different directions (R, L, and Re), distances (Z1, Z2, and Z3), and depths (0, 5, and 10cm). One-way analysis of variance (ANOVA) with a 5% significance level was used to compare (mean ±SE) of the physico-chemical characteristics of the soil at different directions (R, L, and Re) and distances (Z1, Z2, and Z3) surrounding the dairy farm. Pearson's product-moment correlation coefficient (R) and the regression coefficients (R^2) were used to determine the Correlation (r) between the prevalence of *E.coli* O157:H7 and the Physico-chemical characteristics of the soil at different directions, distances, and depths of the dairy farm.

Results and Discussion

Prevalence of *E.coli* O157:H7 in soil at different directions, distances, and depths (0, 5 and 10cm). Of 72 soil samples collected during the period of the study 48 (67%) were positive for *E.coli* O157:H7 in all directions (R, L, and Re) of the dairy farm. The highest prevalence was recorded at the L-side (left) of the farm (79%), followed by Re (Rear)-sides (67%) and the R (Right) of the farm (54%). Overall, no significant differences in the prevalence of *E.coli* O157:H7were observed among L×R, or L× Re. The results further demonstrated that the prevalence of *E.coli* O157:H7 in the soil at different distances (Z1, Z2 and Z3) of the farm were 52% (14/27), 63% (17/27) and 94% (17/18) for Z1, Z2 and Z3 respectively. Overall, there was a significant ($P<0.05$) differences between Z1and Z3 or Z2 and Z3 (Table, 1).

The overall prevalence of *E.coli* O157:H7 at different depth (0, 5, and 10 cm) irrespective of the directions (L, R and Re) and distances (Z1, Z2 and Z3) were illustrated in Fig. 1. The highest prevalence was recorded on the surface (0-depth, 85%), followed by 5cm (67%), and 10cm (39%). The prevalence of *E.coli* O157:H7 contamination transferred to the interior of soil decreased with increased depths ($r = -0.97$) of penetration, this correlation is highly significant ($R^2 = 0.94$) (Fig.1). Comparing the prevalence of *E.coli* O157:H7 between the surface (0 cm) and 5cm revealed no significant differences, but significant ($P<0.05$) differences were recorded between surface (0cm) and 10cm, or between 5cm and 10cm.

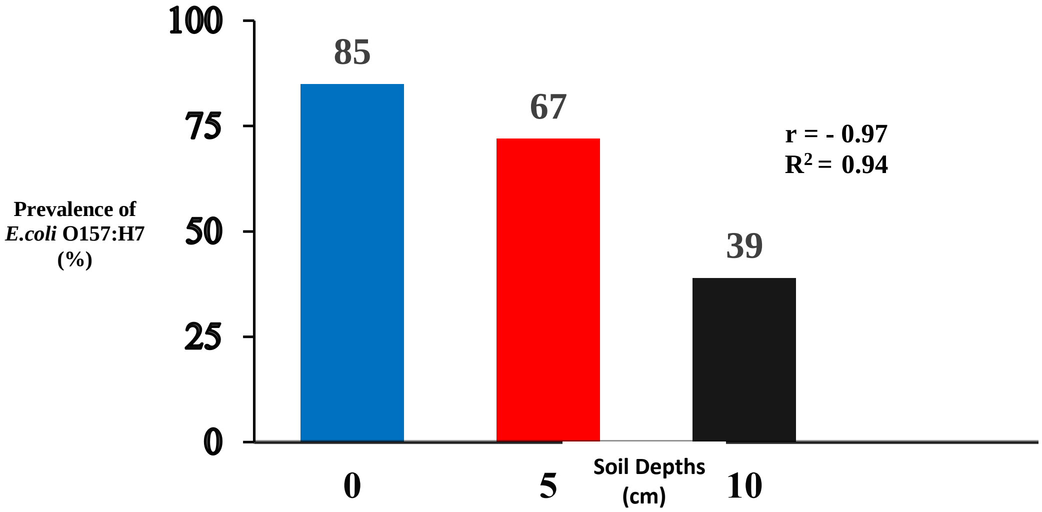
The survival characteristics of *E.coli* O157:H7 in amended soils could be greatly affected by natural environmental factors. In fact, soil and more generally the environment is one of the main pathways of *E.coli* O157:H7 human infections, and a trend of environmental outbreaks outnumbering burger–outbreaks are actually observed (13). Many studies have reported differences in *E.coli* O157:H7 soil survival rates according to diverse experimental conditions, these experiments were mostly conducted in climate–controlled laboratory or greenhouses. Therefore, the data might not reflect the survival rate of *E.coli* O157:H7 in soil under fluctuating weather that would be seen in a commercial Dairy farm. Other research showed that *E.coli* O157:H7 cells survived for up to 231 days in manure amended soil held under laboratory conditions at 21°C (14). In comparison (15) reported shorter survival period of this pathogen , which was detected for 69 days in garden plots fertilized with cattle manure and 105 days on pasture contaminated by sheep feces , respectively. In a real field situation, manure was generally left on the soil surface for typically up to 1 week before its incorporation in soil (16), were the bacteria can be affected by various environmental stresses.

The highest prevalence of *E.coli* O157:H7 in the soil at different directions (R, L and Re) and at different distances (Z1, Z2, and especially Z3 (94%), (Table, 1) could be explained by the fact that *E.coli* O157:H7 may be introduced into the soil through irrigation water contaminated with cattle feces or through contact with contaminated surface runoff from the dairy farm. These results are in agreement with (17). Further, (5) indicated that animal feces and irrigation water are the main avenues for the spread of human pathogens to field and the crops growing there. These results further highlight the important role of the cattle feces in contaminating the soil and the farm environment surrounding the farm. When microorganisms are introduced on or in soil, their movement is determined by the flow of percolating water (18). Like other bacteria, *E.coli* O157:H7 is able to move through the soil profile with water after rainfall or irrigation and can even reach the groundwater (19 and 20) as shown in (Fig.1) , the movement of *E.coli* O157:H7 into the farm soil decreased with increased depths (0cm, 5cm, and 10cm). These results could be explained by the facts that attachment of the pathogens to manure particles in the upper soil layer probably led to reduced percolation to deeper soil layer (21). Other, researcher (21 and 22) who demonstrated that *E.coli* O157:H7 has the potential to survive and move vertically into the soil with time. Saini, *et al.*, (23) suggested that microorganisms found in manure prefer to retain in upper layers of soils and because the preferable pore size between soil particles, pH levels, temperatures, soluble organic materials, and available water favor their growth. Also, movement of pathogens from contaminated manure through the soil profile depends on the type of soil, manure physicochemical, and the climate. Further explanation as suggested by (24) was that the presence or absence of oxygen in soil may also lead to differences in survival time of entero pathogens. The behavior of *E.coli* O157:H7 cannot be easily predicted since this pathogen is facultative anaerobic bacteria and is able to use aerobic and anaerobic types of metabolism in different oxygen conditions. Other studies have reported that micro flora originating from soils exhibit antagonistic interaction with *E.coli* O157:H7 when introduced into the soil as well as when they were introduced into manure amended soils (14).

Table, 1: Prevalence of *E.coli* O157:H7 in soil surrounding the dairy farm at different distances, depths, and directions.

Distances	Z1 (1m)			Z2 (5m)			Z3 (10m)			Total No.+ve/Total Samples tested	Prevalence (%)
Depths / Directions	0	5	10	0	5	10	0	5	10		
R	3/3	0/3	2/3	2/3	0/3	0/3	3/3	3/3	NT	13/24	54
L	3/3	2/3	0/3	3/3	2/3	3/3	3/3	3/3	NT	19/24	79
Re	2/3	2/3	0/3	2/3	3/3	2/3	2/3	3/3	NT	16/24	67
No+ve/No.tested	8/9	4/9	2/9	7/9	5/9	5/9	8/9	9/9	----		
Total No.+ve/Total Samples tested	14/27			17/27			17/18			48/72	
Prevalence (%)	52 B			63 B			94 A			67	

Z=Zone, O=Surface, NT=Not tested (tilled land), R=Right side, L=Left side, and Re=Rear side of the farm
Different uppercase letters in the same row are significantly different (P<0.05)



Figure, 1: Overall Prevalence of *E.coli* O157:H7 from the soil at different depths (0, 5, and 10 cm) irrespective of the directions and distances.

Comparison of the physico-chemical characteristics of the soil at different directions and distances. At the right side of the farm (R), the mean pH, water contents %, sand %, and clay %, did not differ significantly across Z1, Z2, and Z3 (F=0.347, P=0.719; F=2.172, P=0.195; F= 0.628, P=0.565, and F=1.141, P=0.381) respectively. Analysis of the data using LSD to test whether there are significant differences between the pH, water contents%, sand% and clay % between Z1× Z2, Z1× Z3 and Z2× Z3, revealed that they did not differ significantly from each other during the course of the study (Table, 2 and Appendix, 1). At the left (L) side of the farm, the pH, and the sand % showed significant (P< 0.05) differences across Z1, Z2, and Z3 (F=8.890, P=0.016; and F=18.696, P=0.002), while there were no significant differences in the water contents % and the clay% (F=1.434, P=0.309; and F=0.203, P=0.821).The LSD values revealed that the significant differences in the pH values were due to the differences between Z1× Z2 (t = 4.14, p=0.014), and Z2× Z3 (t =2.761, P= 0. 05). While the LSD value for the sand% was due to the significant difference between Z1× Z2 (t= -5.646, P=0.004) and Z2× Z3 (t= 4.857, P=0.008 respectively). The results also showed that there were no significant differences in the LSD values between Z1, Z2, and Z3 for the water contents, and clay % (Table, 3 and Appendix, 2). At the rear (Re) side of the farm, no significant differences were observed between Z1, Z2 and Z3 for the pH, water contents %, sand %, and clay % (F=1.094, P=0.403; F=1.780, P=0.260; F=1.081, P=0.407; and F=1.798, P=0.258 respectively). The LSD values between Z1× Z2, Z1× Z3 and Z2× Z3 (Table 4 and Appendix 3), indicated that there were no significant differences in the mean of the pH, water contents%, sand%, and clay % during the course of the study.

Manure application practices involve the spreading, injection, incorporation, or irrigation of manure on, into, or upon land. The suitability, limitations, or hazards associated with these practices depend upon and are influenced by geographic variability of the soil and soil properties within the application (8). The survival period of *E.coli* O157:H7 in soil after application of contaminated manure may depend on soil management practices (e.g. organic versus conventional), manure type and method used for application, available substrate in relation to microbial competition, bacterial diversity, temperature, moisture, and presence of oxygen (25). The effect of chemical composition of manure and soil amended with manure on human enteropathogens has been investigated (26 and 27) and factors like, moisture content and oxygen status (28), pH (29), and temperature (2,28 - 30) were shown to be important too. Different combinations of all these factors lead to differences in survival of *E.coli* O157:H7 in manure and soil. (31), also concluded that both abiotic (temperature, pH, soil type) and biotic (composition, and diversity of the microbial community) factors affect survival capabilities of bacteria introduced into the soil. Most of these studies considered the effects of soil characteristics independently. Since the extent to which these factors affect survival most likely depends on interactions between the various environmental factors, the overall set of abiotic and biotic soil characteristics should be taken into account (14). Overall results of this study showed that there were no significant differences in the physico–chemical characteristics of the soil examined in all directions(R, L, and Re) or depths of the soil of the farm, except on the left (L) side were the pH (Z1×Z2, and Z2×Z3), and sand %(Z1×Z2, and Z2×Z3), (Tables 2, 3, and 4) showed significant ($P < 0.05$) differences. In general, although there was a great deal of variability in data and statistically significant differences were not consistently observed, *E.coli* O157:H7was detected in the soil amended with cattle manure during the study period (6 months). The multivariate physico–chemical characteristics of the soil examined in this study gives integrated measures of soil quality, and that soil variables respond differently to an impact, and results in different survival rate of *E.coli* O157:H7 in the soil.

Table, 2: Comparison (mean ±SE) of the physico-chemical characteristics of the soil at different distance (Z1, Z2, and Z3) collected from the right (R) side of the farm .

Soil Characteristics / Distance(Z)=Meter	Mean±SE		
	Z1 = 1m	**Z2 = 5m**	**Z3 = 10m**
pH	**7.2±0.2**	**7.3±0.08**	**7.2±0.2**
Water Content (%)	**11.7±3.8**	**12.6±3.7**	**17.5±3.5**
Sand (%)	**41±12.9**	**32±5.5**	**39±11**
Clay (%)	**24±7.6**	**17±2.5**	**23±7.0**

Appendix, 1: LSD to test the significant differences of the physico-chemical characteristic of the soil between Z1×Z2, Z1×Z3, and Z2×Z3 of the right (R) side of the farm.

Statistical Analysis / Soil Characteristics	F	P	Z	LSD t	LSD df	LSD P
pH	**0.347**	**0.7199**	1×2	**-0.722**	**4**	**0.5104**
			1×3	**0.000**	**4**	**1.0000**
			2×3	**0.722**	**4**	**0.5104**
Water %	**2.172**	**0.1952**	1×2	**-0.300**	**4**	**0.7788**
			1×3	**-1.936**	**4**	**0.1249**
			2×3	**-1.636**	**4**	**0.1772**
Sand %	**0.628**	**0.5656**	1×2	**1.067**	**4**	**0.3461**
			1×3	**0.237**	**4**	**0.8242**
			2×3	**-0.830**	**4**	**0.4533**
Clay %	**1.141**	**0.3801**	1×2	**1.397**	**4**	**0.2350**
			1×3	**0.200**	**4**	**0.8516**
			2×3	**-1.197**	**4**	**0.2973**

LSD between Z1×Z2, Z1×Z3 and Z2×Z3

Table, 3: Comparison (mean ±SE) of the physico-chemical characteristics of the soil at different distances (Z1,Z2, and Z3) collected from the left (L) side of the farm .

Soil Characteristics / Distance(Z)=Meter	Mean±SE		
	Z1 = 1m	Z2 = 5m	Z3 = 10m
pH	B 7.3±0.1	A 7.6±0.06	B 7.4±0.1
Water Content (%)	11.3±1.4	11.3 ± 1.3	15±5
Sand (%)	B 27.7±5.1	A 51.3±1.9	B 31±7.0
Clay (%)	29.7±3.8	26±7.6	26±7.8

Appendix, 2: LSD to test the significant differences of the physico-chemical characteristics of the soil between Z1×Z2, Z1×Z3, and Z2×Z3 of the left (L) side of the farm.

Statistical analysis / Soil Characteristic	F	P	Z	LSD			
				T	df	P	
pH	8.890	0.0161	1×2 1×3 2×3	4.141 1.380 2.761	4 4 4	0.0144 0.2396 0.050	* *
Water %	1.434	0.3098	1×2 1×3 2×3	0.000 -1.466 -1.466	4 4 4	1.000 0.2164 0.2164	
Sand %	18.696	0.0026	1×2 1×3 2×3	-5.646 -0.790 4.857	4 4 4	0.0048 0.4740 0.0083	* *
Clay %	0.203	0.8217	1×2 1×3 2×3	0.552 0.552 0.000	4 4 4	0.6105 0.6105 1.000	

LSD between Z1×Z2, Z1×Z3 and Z2×Z3

*** = significant difference ($p < 0.05$).**

Table, 4: Comparison (mean ±SE) of the physico-chemical characteristics of the soil at different distances (Z1, Z2, and Z3) collected from the rear (Re) side of the farm.

Soil Characteristics / Distance(Z)=Meter	Mean±SE		
	Z1 = 1m	Z2 = 5m	Z3 = 10m
pH	7.4±0.1	7.5±0.08	7.5±0.1
Water Content (%)	12.3±3.0	13 ± 1.0	18.5±6.5
Sand (%)	43.3±16.9	39±3.8	28±8.0
Clay (%)	21.7±3.8	20±1.0	25.5±4.5

Appendix, 3: LSD to test the significant differences of the physico-chemical characteristics of the soil between Z1×Z2, Z1×Z3 and Z2×Z3 of the rear (Re) side of the farm.

Statistical Analysis / Soil Characteristic	F	P	Z	LSD		
				t	df	P
pH	1.094	0.4035	1×2 1×3 2×3	-1.324 -1.184 0.000	4 3 3	0.2562 0.3218 1.000
Water %	1.780	0.2608	1×2 1×3 2×3	-0.224 -1.776 -1.575	4 3 3	0.8336 0.1738 0.2132
Sand %	1.081	0.4073	1×2 1×3 2×3	0.457 1.454 1.046	4 3 3	0.6714 0.2418 0.3726
Clay %	1.798	0.2581	1×2 1×3 2×3	0.651 -1.302 -1.884	4 3 3	0.5505 0.2839 0.1561

LSD between Z1×Z2, Z1×Z3, and Z2×Z3

Correlation between the prevalence of *E.coli* O157:H7 and the Physico-chemical characteristics of the soil. On the right (R) side of the farm the correlation between the prevalence of *E.coli* O157:H7 and the physico – chemical characteristics of the soil at Z1, Z2 and Z3 at the depth of 0, 5cm and 10cm are presented in (Table, 5) At Z1 (1m) statistical analysis revealed that there were negative correlations (r = - 0.94, r = - 0.59, and r = - 0.64), although non-significant between the prevalence of *E.coli* O157:H7 and the pH, water contents%, and clay % respectively. While, the correlation with the sand % was positive (r =+ 0.53), although non-significant. At Z2 (5m), the correlation between the prevalence of *E.coli* O157:H7 and the soil pH, water contents %, and clay % were negative (r = - 0.94, r = -0.50, and r = -0.99 respectively). While, the correlation with the sand % was positive (r = + 0.45), although, non of them were significant. At Z3 (10m), the correlation between the prevalence of *E.coli* O157:H7 and the soil pH, water contents %, sand%, and clay % were positive (r = + 0.99, r = + 0.94, r = + 0.89, and r = + 0.88 respectively). Interestingly, all the correlations were very strong, although, non-significant, except for the pH (p<0.05). On the left (L) side of the farm, and at Z1 (Table, 6), the correlation between the prevalence of *E.coli* O157:H7 and the physico – chemical characteristics of the soil, showed positive correlation with the pH (r = + 0.56), water contents % (r = +0.99), sand % (r = +0.78), and a negative correlation (r = - 0.99) for the clay %. However none of them were significant (p<0.05). At Z2 (5m), the correlation between the prevalence of *E.coli* O157:H7 with the soil pH, and water contents % were negative (r = - 0.94, r = - 1.00 respectively), although not significant for the pH, but significant for the water contents % (p<0.05). While, the correlation with the sand % and the clay % were positive (r = +0.62, and r = +0.47 respectively). None of them were significant. Analyzing the data at Z3 (10m) revealed that the correlation between the prevalence of *E.coli* O157:H7 and the physico – chemical characteristics of the soil were all positive (r = +1.00, r = +0.86, r =+0.93, and r =+0.94 for the pH, water contents %, sand %, and clay % respectively). However, only it was significant for the sand % correlation (p<0.05).

On the rear (Re) side of the farm, and at Z1 (Table, 7) the data analysis showed that the correlation between the prevalence of *E.coli* O157:H7 and the physico – chemical characteristics of the soil were all positive (r = +0.75, r = +0.19, r = + 0.66, and r = +0.07 for the pH, water contents %, sand %, and clay % respectively), although non of them were significantly differ (p<0.05). At Z2 (5m), the correlation of *E.coli* O157:H7 were positive for the pH (r = +0.18), and the clay % (r = + 0.99), while negative for water contents % (r = - 0.86) and for the sand % (r = - 0.95). However, only the clay % was significantly (p<0.05) differ At Z3 (10m), the correlation between the prevalence of *E.coli* O157:H7 and the physico – chemical characteristics of the soil, revealed that there were positive correlation with the pH , water contents %, sand %, and clay % (r = +0.95, r = +0.64, r = +0.70, and r = + 1.00 respectively). However, only the correlation of the clay % was significantly (p<0.05) differ.

Survival of *E.coli* O157:H7 is very dependent on environmental condition such as rainfaill, soil temperature and humidity. *E.coli* O157:H7 is said to have the ability to leach through soil together with rainfall, which again suggests that drought conditions in the soil would decrease the survival rate of the pathogen (32). In addition, survival of *E.coli* O157:H7 has been reported to be prolonged in finer textured soils (2 and 33). In addition, fine sandy soils have a lesser clay content than some other soil types. One study reported that the population of E.coli O157:H7 declined faster in sandy soils than in clay soil; the clay soils were believed to have more pore niches that served to protect enteric bacteria from natural environmental factors in the soil and the bacteria are better able to adhere to soil particle which also help to preserve their number overtime (34). However, most published data on the survival of *E.coli* O157:H7in soil typically included only a limited number of different soils, which does not fully justify generalized conclusions on the effect of soil type under field conditions. Moreover, most studies considered the effects of soil characteristics independently. Since the extent to which these factors affect the survival of *E.coli* O157:H7 most likely depends on interactions between the various environmental factors, such as abiotic and biotic soil characteristics. In contrast the present study included different soils types from different directions, distances, and depths of the dairy farm during the study period, and showed different prevalence of *E.coli* O157:H7 among soil types. This is probably related to the absence of significant differences in the physico–chemical characteristics and biological soil characteristics among different directions (R, L and Re), distances (Z1, Z2 and Z3) or depths (0 cm, 5 and 10). The data collected during the study periods (Tables, 5, 6 and 7), revealed that, the physico–chemical characteristics factors examined (pH, water content %, sand %, and clay %) showed variable correlation (+ve or –ve, but generally not significant) with the prevalence rate of *E.coli* O157:H7. This observation could be explained by different soil texture of the dairy farm under investigate.

Table, 5: Correlation (r) between the prevalence of *E.Coli* O157:H7 and physico-chemical characteristics of the soil at the right (R) side of the dairy farm.

Distance(Z)=Meter		Z1 = 1					Z2=5					Z3=10				
Depth cm		0	5	10	r	P<0.05	0	5	10	r	P<0.05	0	5	10	r	P<0.05
***E.Coli* O157:H7**	**No. of +ve Samples /Total Samples tested 1**	3/3	2/3	0/3	-----	-----	3/3	2/3	3/3	------	------	3/3	3/3	NT	------	------
Soil characteristic	**pH 2**	7.3	7.6	7.1	+0.56	0.616	7.5	7.5	7.5	- 0.94	0.212	7.3	7.5	NT	+1.00	0.149
	Water Content (%) 3	9	11	14	+0.99	0.502	10	14	10	- 1.00	0.002	20	10	NT	+0.86	0.333
	Sand (%) 4	38	23	22	+0.78	0.421	50	49	55	+0.62	0.56	38	24	NT	+0.93	0.007
	Clay (%) 5	23	38	36	-0.99	0.391	15	16	41	+0.47	0.68	21	32	NT	+0.94	0.219

0=Surface, NT=Not tested (tilled land), 1=Prevalence, 2=pH, 3=Water contents%, 4=Sand%, and 5=Clay%
Correlation = 1×2, 1×3, 1×4, and 1×5

Table, 6: Correlation (r) between the prevalence of E.Coli O157:H7 and physico-chemical characteristics of the soil at the left (L) side of the dairy farm.

Distance(Z)=Meter		Z1 = 1					Z2=5					Z3=10				
Depth cm		0	5	10	r	P<0.05	0	5	10	r	P<0.05	0	5	10	r	P<0.05
***E.Coli* O157:H7**	**No. of +ve Samples / Total Samples tested 1**	3/3	0/3	2/3	-----	-----	2/3	0/3	0/3	------	------	3/3	3/3	NT	------	------
Soil characteristic	**pH 2**	7	7.7	7	- 0.94	0.209	7.2	7.4	7.5	- 0.94	0.212	7	7.5	NT	+0.99	0.038
	Water Content (%) 3	4	14	17	- 0.59	0.598	9	9	20	- 0.50	0.666	14	21	NT	+0.94	0.212
	Sand (%) 4	66	35	22	+0.53	0.642	37	38	21	+0.45	0.700	50	28	NT	+0.89	0.289
	Clay (%) 5	9	30	34	- 0.64	0.551	12	20	19	- 0.99	0.073	16	30	NT	+0.88	0.308

0=Surface, NT=Not tested (tilled land), 1=Prevalence, 2=pH, 3=Water contents%, 4=Sand%, and 5=Clay%
Correlation = 1×2, 1×3, 1×4, and 1×5

Table, 7: Correlation (r) between the prevalence of *E.Coli* O157:H7 and physico-chemical characteristics of the soil at the rear (Re) side of the dairy farm.

Distance(Z)=Meter		Z1 = 1					Z2=5					Z3=10				
Depth cm		0	5	10	r	P<0.05	0	5	10	r	P<0.05	0	5	10	r	P<0.05
E.Coli O157:H7	No. of +ve Samples / Total Samples tested 1	3/3	2/3	0/3	-----	-----	2/3	3/3	2/3	------	------	2/3	3/3	NT	------	------
Soil characteristic	pH 2	7.4	7.8	7.2	+0.75	0.454	7.4	7.6	7.7	+0.18	0.878	7.4	7.7	NT	+0.95	0.188
	Water Content (%) 3	7.8	18	11	+0.19	0.874	12	15	12	- 0.86	0.333	25	12	NT	+0.64	0.558
	Sand (%) 4	77	25	28	+0.66	0.537	37	46	33	-0.95	0.194	36	20	NT	+0.70	0.502
	Clay (%) 5	14.7	27.7	22	+0.07	0.954	21.2	17.6	21	+0.99	0.031	20.5	30	NT	+1.00	0.009

0=Surface, NT=Not tested (tilled land), 1=Prevalence, 2=pH, 3=Water contents%, 4=Sand%, and 5=Clay%
Correlation = 1×2, 1×3, 1×4, and 1×5

In conclusion, the physico-chemical characteristics of the soil examined, PH, moisture %, sand%, and clay % showed either no consistent or weak correlations with the prevalence of *E.coli* O157:H7 at the dairy farm reared under field conditions. The movement of *E. coli* O157:H7 from cattle wastes through the environment is a complex issue. A better understanding of the movement of *E. coli* O157:H7 in soil was achieved and factors that might contribute to the survival of *E. coli* O157:H7 in soils were identified.

The significance of the present study is that the soil samples were naturally contaminated with *E.coli* O157:H7. The prevalence of *E. coli* O157:H7 found in this study are far greater than what would likely be found on a dairy farm in other countries; this is a critically important fact considering that, under natural conditions, even a low level of contamination of *E. coli* O157:H7 with a low infective dose could present a human health hazard.

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العلاقة بين انتشار جرثومة *E. coli* O157:H7 والخصائص الفيزيائية والكيميائية للتربة في حقل ابقار انتاج الحليب تحت الظروف الميدانية في محافظة بغداد

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الخلاصة

صممت هذه التجربة للتعرف على العلاقة بين عوامل الإجهاد المختلفة للتربة (الاس الهيدروجيني، الرطوبة، وقوام التربة.) في قابلية جرثومة *Escherichia coli* OI57: H7 على البقاء على/ في التربة تحت الظروف الطبيعية لحقل ابقار كلية الزراعة / جامعة بغداد. تم تحديد وجود جرثومة *E. coli* O157:H7 في عينات التربة للفترة بين شهري كانون الثاني إلى نهاية حزيران 2012, اخذت العينات من ثلاثة مناطق اعتمادا على البعد عن الحقل فكانت المنطقة الأولى على بعد 1 متر عن سور الحقل (Z1)، والمنطقتين الاخريين على مسافة 5, و 10 متر عن سور الحقل (Z5، وZ10، على التوالي) ومن ثلاثة اتجاهات (يمين, يسار والجهة الخلفية من الحقل) كذلك اعتمدت ثلاثة أعماق (سطح التربة, 5 و 10 سنتيمتر) لأخذ العينات من كل منطقة معتمدة وللاتجاهات الثلاث. تم جمع 9 عينة من التربة (200 غرام للعينة) في أكياس من البلاستيك من كل منطقة معتمدة من المزرعة ولكل عمق من صفر (سطح) و5 و10 سم أسبوعيا. قسمت العينات الى نصفين, النصف الأول (100 غرام) للفحوصات الفيزيوكيميائية (الاس الهيدروجيني, نسبة الرطوبة, نسبة الرمل, ونسبة الطين). والنصف الثاني من عينات التربة (100 غرام) لتحديد وجود *E. coli* O157:H7. أظهرت النتائج وجود ارتباط ضعيف او عدم وجود ارتباط ثابت بين عوامل الإجهاد المختلفة للتربة مع انتشار *E. coli* O157:H7 في التربة تحت ظروف الحقل الطبيعية. كما أظهرت وجود جرثومة *E. coli* O157:H7 بمقدار أكبر بكثير مما وجد في تربة حقول الابقار في البلدان الأخرى، وهذه حقيقة بالغة الأهمية بالنظر إلى أنها تشكل خطرا على صحة الإنسان حتى على مستوى منخفض من التلوث بجرثومة *E. coli* O157:H7 .

الكلمات المفتاحية: *E.coli* O157:H7, عوامل الاجهاد، التربة، الاس الهيدروجيني، الرطوبة، قوام التربة.