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Environmental Awareness of University Students on White Cheese Waste Water

Doğa Kavaz [1*], Hüseyin Öztoprak [2]

[1] Department of Bioengineering, Cyprus International University, Nicosia, N. CYPRUS via Mersin 10 TURKEY
[2] Department of Electrical and Electronics Engineering, Cyprus International University, Nicosia, N. CYPRUS via Mersin 10 TURKEY

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ABSTRACT

Universal environmental contamination is a real situation that deteriorates our world step by step. The dairy factory out flowing is the second greatest source of contamination in water streams. The environmental impact of these factories can be very high, especially due to the discharge of wastewater with high content of organic matter and nutrients. These problems can be analyzed only after performing factual study of various physicochemical characteristics. In the presented study, physicochemical parameters like, temperature, pH, COD, TDS, TS and SS were taken into account. Another purpose of this study is to ascertain university student's awareness and consciousness against general and dairy products related environments. These levels were evaluated by the survey method. The data obtained from the questionnaire were analyzed using SPSS 20.0. Results showed that the public and company owners/ employees in particular should be informed about the seasonal and cheese variety dependent patterns in environmental pollution.

Keywords: environmental awareness, white cheese, halloumi, seasonal patterns, waste water

INTRODUCTION

Environmental, biological, chemical, and social factors that always lead to the development of living organisms and maintain them under steady influence. This definition refers to both natural and artificial environmental factors. There is regular conflict of interest between the natural and artificial environmental factors (Ceritli, 2001). The ecological balance between them had been functioning effectively for centuries but has recently become impaired in such a way that one cannot see this functioning anymore. Moreover, the amount of waste generated is higher to the extent that cannot be neglected in the ecological balance and the nature cannot accommodate them in its own structure. Every person has the right to live in a healthy environment, however recent rapid population growth in the last century, industrialization and unlimited use of resources have resulted in rapid increase of environmental pollution of the earth (Kaul et al., 1993).

Industrialization is backbone for development of all countries. However pollution caused by industrial activities is of serious concern throughout the world. The food sector has one of the highest water consumption and is one of the biggest producer of effluent per unit of production. Additionally it generates large volume of sludge in biological treatment system. The dairy industry is an example of this sector and is one of the principal sources of high effluent generation in European industries (Demirel et al., 2005).

The dairy industry enables the production of highly nutritional foods with the introduction of modern equipment. The activities of dairy industry includes, the transformation of raw milk into pasteurized and sour milk, yoghurt, hard, soft and cottage cheese, cream and butter products, ice cream, milk and whey powders, lactose, condensed milk, as well as various types of desserts. The functional characteristics as well as health safety and nutritional features of the new generation dairy products have been studied for many years (Watkinsa and Nash, 2010).

✉ dogakvz@gmail.com **(*Correspondence)** ✉ hoztoprak@ciu.edu.tr

Contribution of this paper to the literature

- According to this study, it was found that both seasonal and variety related patterns play a role in the chemical output of the dairy production.
- The undergraduate students and male students that participated in the study have revealed less concern about both general and dairy related environmental issues and they need to be educated.
- The study also pointed out the level of environmental awareness of Cyprus International University students. The study also pointed out some essential aspect that need an urgent response.

Whey protein is often used in daily activities because of its high nutritional quality as well as its ability of providing physical stability and acting as an emulsifier (Anja et al., 2017). The stabilizing effect of whey proteins is due to its higher molecular weight. And the hydrophilic/hydrophobic distribution of amino acids in peptides is responsible for the emulsion forming ability (Rahali et al., 2000).

Whey is produced at varying levels of serum components such as lactoalbumin and lactoglobulin from the milk components remaining after the coagulation process during cheese making lactose, fat, minerals and vitamins. Although it differs according to the cheese construction, 70-90% of the used pumice is obtained as cheese water (Alichanidis and Polychroniadou, 2009). Halloumi (Hellim) is a semi-rigid cheese type that originates from Cyprus and other Eastern Mediterranean countries. Traditionally, halloumi is produced from sheep milk or sheep-goat milk mixture, but production from cow milk has become increasingly widespread in recent years (Papademas and Robinson, 1998). It is known that the color of halloumi cheese produced from sheep and / or goat milk is white while halloumi produced from cow milk is yellowish.

In case of disposal without evaluation special sewage system is needed to remove the whey and/or halloumi waste water from the factory. If there a sewage system is not available, it is necessary to transport this material in tanks. However, this process is very costly and takes a long period of time. In the case of transportation, the chosen area be remote from residential areas and cheese water should never be left in streams or stagnant waters. Because organic materials, which are not subjected to any treatment, are present in whey, there may be in water. This will cause considerable environmental pollution, and endangerment of living creatures. Cheese whey contained organic and saline effluent whose properties and treatment have not been clearly addressed, and the whey wastewater generation is much higher than the volume of processed milk (Fateema et al., 2012). In many developed countries, it is forbidden to leave the water of the cheese/whey to the sewer or surrounding area without being subjected to any treatment. Despite the fact that this product is evaluated in various forms in developed countries according to the nutritional value of the food items contained in the cheese juice developing countries are struggling in this regard (Kolhe and Pawar, 2011).

Environmental pollution, which once seemed to be ignorable, has become focus of the public with the arrival of health detoriating and life threatening points. The level that a person perceives the environmental pollution as a risk can vary according to her knowledge about the subject. This knowledge is related to the persons past experience, and the audiovisual and written media. The development and conservation of environmental awareness is possible through environmental education (Çabuk and Karacaoğlu, 2003). The characterization, treatment of halloumi and whey waster should be conducted in order to educate people about it and prevention measures should be employed. The purpose of this education is to lead every member of society to develop positive awareness and attitude that is sensitive to the environment. An educational system that responds positively to environmental incentives and actively participates in environmental issues should be developed. In this way, environmentally sensitive individuals can be raised.

METHOD

Research Design

This study uses a joint methodology that aims to investigate the environmental impact of dairy industry and the public awareness about it at the same framework. The study consists of two parts. In the first part, samples of both white cheese and halloumi wastewater were collected from the dairy factory located in the selected region and chemical analysis was carried out. For the second part, a study prepared by asking Cypriot university students views on the attitude and behavior towards the general environment and dairy waste. In other words, this research was prepared in accordance with a survey model. The research model is a methodology that includes various data collection techniques.

Area of Study

The source for the collection of wastewater samples throughout the present studies was the Dairy industry located in Haspolat, Lefkoşa.

Material Requirements

All the glassware, casserole and other pipettes were first cleaned with tape water thoroughly and finally with de-ionized distilled water. The pipettes and burette were rinsed with solution before final use. The chemicals and reagent were used for analysis were of analytical reagent grade. The procedure for calculating the different parameters were conducted in the laboratory.

The Chemical Analysis on the Discharge of Dairy Factory

The samples were collected and analyzed for temperature, pH, Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Chemical Oxygen Demand (COD) values. The techniques and methods followed for collection, preservation, analysis and interpretation (Rainwater and Thatcher, 1960), (Carawan et al., 1979), (Hem, 1985) (APHA, 1995).

For the environmental impact of dairy industry, measurements were done on the Halloumi and white cheese by products obtained from Haspolat Dairy factory. The analysis were done on the five samples taken from Halloumi and white cheese discharge during both in 2016 summer (month) and 2017 winter (month). In particular, the impact of operating season and the cheese variety on the chemical parameters were analyzed by using ANOVA as the statistical test.

The Survey about the Environmental Awareness

For the awareness about the environmental impact of dairy industry, a survey based on data collection method with 95 % confidence level and 5% sampling error was utilized. This section of the study was designed according to quantitative relational screening model. Relational screening model targets to compute the correlation between two or more variables (Gündüz et al., 2016). Correlation research is a major component of social sciences which reveals relations between variables in a seamless fashion. This type of research can lead the scientists to investigate the cause effect relationships among variables once correlation among them is found (Büyüköztürk, 2008).

The population for the research included 194 Turkish Cypriot students from Cyprus International University (CIU). The population size was selected according to the confidence interval required for a total of 394 Turkish Cypriot students that are studying in CIU. The population included both undergraduate and postgraduate students. The survey was realized in 2017.

The survey was designed as two-dimensional; one dimension being the awareness about the environmental impact of dairy industry and the other being the general environmental awareness. To ensure the validity of data collection, open and comprehensible language was used.

Data Analysis

The data obtained from the chemical measurements and surveys was investigated by using SPSS 20.0 program. The seasonal and variety dependent patterns in chemical measurements were analyzed using ANOVA and the survey results were analyzed using ANOVA, pyramid charts and dependent t-test.

Validity-Reliability Study

In order to test the reliability of the data collection method, Cronbach Alpha value was calculated. Final state of the scale was constructed by eliminating the items that might decrease the scale's Cronbach Alpha value. After eliminating the items in the scale that lower the reliability and the initial 30 questions were decreased to 24 questions. The final survey comprised 13 questions about general environmental awareness and 11 questions about dairy industry related environmental awareness. Cronbach Alpha Reliability Coefficient was found as 0.816. This value is considered sufficient considering the reliability of the scale according to literature (Tavakol and Dennik, 2011).

Table 1. Comparison of measurements with respect to cheese type (Summer)

		Value			ANOVA			
		Samples	Mean	SD	CI 95%		Mean Difference	*p* value
					Lower	Upper		
Temperature	Halloumi	5	28.5	0.7	-0.8	1.0	0.1	0.809
	White cheese	5	28.4	0.5	-0.8	1.0		
pH	Halloumi	5	5.2	0.3	0.1	0.8	0.4	*0.019
	White cheese	5	4.8	0.0	0.0	0.9		
COD	Halloumi	5	12964.0	240.2	1818.9	2420.3	2119.6	*< 0.001
	White cheese	5	10844.4	165.3	1812.1	2427.1		
EC	Halloumi	5	6.8	0.1	-0.6	-0.3	-0.5	*< 0.001
	White cheese	5	7.3	0.1	-0.6	-0.3		
Turbudity	Halloumi	5	816.0	38.1	100.1	338.3	219.2	*0.003
	White cheese	5	596.8	109.0	86.2	352.2		
Nitrite	Halloumi	5	10.0	0.2	3.4	5.1	4.2	*< 0.001
	White cheese	5	5.7	0.8	3.2	5.2		
Nitrate	Halloumi	5	401.0	15.2	176.5	214.7	195.6	*< 0.001
	White cheese	5	205.4	10.6	176.1	215.1		
Sulfate	Halloumi	5	381.4	13.8	-593.1	-440.1	-516.6	*< 0.001
	White cheese	5	898.0	72.9	-606.4	-426.8		
Phosphate	Halloumi	5	27.8	1.3	-0.1	2.7	1.3	0.071
	White cheese	5	26.5	0.5	-0.3	2.9		
TDS	Halloumi	5	42060.4	1333.5	-9383.9	-6183.3	-7783.6	*< 0.001
	White cheese	5	49844.0	793.5	-9449.6	-6117.6		
TSS	Halloumi	5	3643.6	163.1	-4360.4	-3592.4	-3976.4	*< 0.001
	White cheese	5	7620.0	334.7	-4387.3	-3565.5		
TS	Halloumi	5	47820.0	1327.4	-14446.8	-11173.2	-12810.0	*< 0.001
	White cheese	5	60630.0	870.1	-14493.3	-11126.7		
TVS	Halloumi	5	2116.0	868.2	-2193.3	93.3	-1050.0	0.067
	White cheese	5	3166.0	689.4	-2203.6	103.6		

RESULTS

Measurements of Pollutant Discharge with Respect to Variety of Cheese and Season

The study was comprise of two parts; the first part has to do with effluent characteristics analysis and the second part involved determination of consciousness and awareness of students in Cyprus International University about dairy environment and general environment.

The experimental part of this study comprised measurements of pollutant discharge with respect to cheese variety and season. In particular, the pollution differences between white cheese/Halloumi and between summer/winter were considered. The study analyzed the effects of dairy production on physical, chemical and biological parameters of the waste water. The measurements included effluent characteristics such as temperature, pH, COD, EC, turbidity, nitrile, nitrate, sulfate, phosphate, TDS, TSS, TS, TVS. The analysis was done with cheese samples obtained from a dairy factory in Haspolat region of Lefkosa City.

The impact of cheese variety (halloumi & white) on the effluent parameters is analyzed for both seasons (**Table 1** and **Table 2**). The temperature of waste water is an important measure with respect to the rate of the chemical and biological reactions, the survival of aquatic animals, and the fitness of the water for useful purposes. The temperature can also play a role in determining the appropriate treatment against the biological reactions. The optimal temperature for operation of secondary wastewater treatment facilities is approximately 25 °C. The temperature data obtained from halloumi and white cheese during summer were compared and they showed no significant difference (**Table 1**) were as that of winter revealed the same (**Table 2**). Determination of pH is a significant objective in the biologically treatment of the wastewater and the pH value is importance for any chemical reaction. The average pH value was higher for Halloumi than white cheese in summer ($p = 0.019$) (**Table 1**). However, the pH value is higher for white cheese than Halloumi in winter ($p < 0.001$) (**Table 2**). The dairy industry generates strong wastewaters like other agro-industries characterized by high COD content. The average COD concentration for white cheese and Halloumi cheese was shown in **Table 1** and **2**. Statistical analysis revealed that the average COD value was higher for Halloumi than white cheese in summer ($p < 0.001$) and higher for white cheese in winter ($p < 0.001$).

Table 2. Comparison of measurements with respect to cheese type (Winter)

		Value			ANOVA			
		Samples	Mean	SD	CI 95%		Mean Difference	*p* value
					Lower	Upper		
Temperature	Halloumi	5	22.6	0.5	-1.3	1.3	0.0	1.000
	White cheese	5	22.6	1.1	-1.4	1.4	0.0	
pH	Halloumi	5	5.1	0.1	-1.2	-0.5	-0.9	*< 0.001
	White cheese	5	5.9	0.3	-1.2	-0.5	-0.9	
COD	Halloumi	5	12888.0	136.8	-808.2	-295.8	-552.0	*0.001
	White cheese	5	13440.0	207.4	-815.3	-288.7	-552.0	
EC	Halloumi	5	6.8	0.1	0.0	0.3	0.2	0.053
	White cheese	5	6.7	0.1	0.0	0.3	0.2	
Turbudity	Halloumi	5	694.4	19.9	40.6	89.0	64.8	*< 0.001
	White cheese	5	629.6	12.4	39.8	89.8	64.8	
Nitrite	Halloumi	5	8.2	0.2	3.3	4.0	3.7	*< 0.001
	White cheese	5	4.5	0.2	3.3	4.0	3.7	
Nitrate	Halloumi	5	317.0	45.2	77.1	174.9	126.0	*< 0.001
	White cheese	5	191.0	14.3	70.8	181.2	126.0	
Sulfate	Halloumi	5	416.0	20.7	-583.6	-516.4	-550.0	*< 0.001
	White cheese	5	966.0	25.1	-583.8	-516.2	-550.0	
Phosphate	Halloumi	5	29.1	2.0	0.2	5.0	2.6	*0.036
	White cheese	5	26.5	1.1	0.1	5.1	2.6	
TDS	Halloumi	5	35550.0	1405.8	12,090.1	15,181.9	13636.0	*< 0.001
	White cheese	5	21914.0	520.5	11,920.5	15,351.5	13636.0	
TSS	Halloumi	5	3458.0	131.6	-6,683.9	151.9	-3266.0	0.059
	White cheese	5	6724.0	3311.6	-7,376.1	844.1	-3266.0	
TS	Halloumi	5	26400.0	1949.4	-7,256.9	-3,235.1	-5246.0	*< 0.001
	White cheese	5	31646.0	44.5	-7,666.1	-2,825.9	-5246.0	
TVS	Halloumi	5	1584.0	139.6	-793.1	-334.9	-564.0	*< 0.001
	White cheese	5	2148.0	172.8	-794.9	-333.1	-564.0	

Comparing the turbidity data of halloumi cheese vs white during summer ($p = 0.003$) and winter ($p < 0.001$) showed statistical difference in favor of Halloumi (**Table 1** and **Table 2**). Sulfate ion concentration of halloumi cheese vs white during summer and winter shows statistical difference when compared ($p < 0.001$).

The impact of season on the effluent parameters is analyzed for both Halloumi and white cheese. The comparisons are tabulated in **Table 3** and **4**. The results in **Table 3** describes the Halloumi measurements with respect to season. There is no significant seasonal difference in pH, COD, EC, Phosphate and TSS measurements. However, summer measurements are significantly higher for temperature ($p < 0.001$), turbidity ($p < 0.001$), nitrite ($p < 0.001$), TDS ($p < 0.001$) and TS ($p < 0.001$). Winter measurements are significantly higher for sulphate ($p = 0.014$).

Table 3. Comparison of Halloumi measurements with respect to season

		Value			Statistical Analysis			
		Samples	Mean	SD	CI 95%		Mean Difference	*p* value
					Lower	Upper		
Temperature	Summer	5	28.2	0.4	4.9	6.3	5.6	*< 0.001
	Winter	5	22.6	0.5	4.9	6.3	5.6	
pH	Summer	5	5.2	0.3	-0.2	0.5	0.2	0.332
	Winter	5	5.0	0.1	-0.3	0.6	0.2	
COD	Summer	5	12964.0	240.1	-209.1	361.1	76.0	0.556
	Winter	5	12888.0	136.8	-222.5	374.5	76.0	
EC	Summer	5	6.8	0.1	-0.1	0.2	0.1	0.359
	Winter	5	6.8	0.1	-0.1	0.2	0.1	
Turbudity	Summer	5	816.0	38.1	77.3	165.9	121.6	*< 0.001
	Winter	5	694.4	19.9	74.6	168.6	121.6	
Nitrite	Summer	5	10.0	0.2	1.5	2.1	1.8	*< 0.001
	Winter	5	8.2	0.2	1.5	2.1	1.8	
Nitrate	Summer	5	401.0	15.1	34.8	133.2	84.0	*0.004
	Winter	5	317.0	45.2	28.8	139.2	84.0	
Sulfate	Summer	5	381.4	13.7	-60.3	-8.9	-34.6	*0.014
	Winter	5	416.0	20.7	-61.0	-8.2	-34.6	
Phosphate	Summer	5	27.8	1.3	-3.8	1.2	-1.3	0.260
	Winter	5	29.1	2.0	-3.8	1.2	-1.3	
TDS	Summer	5	42060.4	1333.5	4512.1	8508.7	6510.4	*< 0.001
	Winter	5	35550.0	1405.7	4511.2	8509.6	6510.4	
TSS	Summer	5	3643.6	163.1	-30.6	401.8	185.6	0.083
	Winter	5	3458.0	131.6	-32.3	403.5	185.6	
TS	Summer	5	47820.0	1327.4	18987.8	23852.2	21420.0	*< 0.001
	Winter	5	26400.0	1949.3	18929.8	23910.2	21420.0	
TVS	Summer	5	2116.0	868.2	-374.9	1438.9	532.0	0.213
	Winter	5	1584.0	139.5	-539.1	1603.1	532.0	

When we compared pH values, halloumi vs white cheese during summer (**Table 1**) was ascertained and the result showed no significant value, whereas that of winter (**Table 2**) showed significance difference ($p < 0.001$). TDS and TSS result of halloumi cheese vs white during summer (**Table 1**) and winter (**Table 2**) were also compared. TDS values for for both values were very high for both varieties and TSS values of white cheese were greater than Halloumi which reached statistical significance only in summer ($p < 0.001$).

The results in **Table 4** illustrates the white cheese discharge during summer and winter period. For white cheese, there is no seasonal statistical difference for turbidity, nitrite, nitrate, sulphate, phosphate and TSS. However, pH ($p < 0.001$), COD ($p < 0.001$) measurements are significantly higher in winter whereas temperature ($p < 0.001$) and EC ($p < 0.001$) are higher in summer. TDS results were also compared between summer and winter and TDS measurements ($p < 0.001$) are higher in summer. The TVS data's showed no significant change with respect to season.

Table 4. Comparison of white cheese measurments with respect to season

		Value			Statistical Analysis			
		Samples	Mean	SD	CI 95%		Mean Difference	p value
					Lower	Upper		
Temperature	Summer	5	28.40	0.5	4.4	7.1	5.80	*< 0.001
	Winter	5	22.60	1.1	4.4	7.1		
pH	Summer	5	4.80	0.0	-1.4	-0.8	-1.14	*< 0.001
	Winter	5	5.94	0.3	-1.5	-0.761		
COD	Summer	5	10844.40	165.3	-2869.0	-2322.1	-2595.60	*< 0.001
	Winter	5	13440.00	207.3	-2871.4	-2319.7		
EC	Summer	5	7.34	0.1	0.5	0.8	0.68	*< 0.001
	Winter	5	6.66	0.1	0.5	0.8		
Turbudity	Summer	5	596.80	108.9	-145.9	80.3	-32.80	0.523
	Winter	5	629.60	12.3	-167.6	102.0		
Nitrite	Summer	5	5.78	0.8	0.3	2.1	1.24	*0.025
	Winter	5	4.54	0.2	.2	2.2		
Nitrate	Summer	5	205.40	10.5	-3.9	32.7	14.40	0.108
	Winter	5	191.00	14.3	-4.2	33.0		
Sulfate	Summer	5	898.00	72.9	-147.5	11.5	-68.00	0.084
	Winter	5	966.00	25.1	-157.0	21.0		
Phosphate	Summer	5	26.50	0.5	-1.2	1.2	< 0.001	1.000
	Winter	5	26.50	1.1	-1.3	1.3		
TDS	Summer	5	49844.00	793.5	26951.3	28908.6	27930.00	*< 0.001
	Winter	5	21914.00	520.4	26923.6	28936.3		
TSS	Summer	5	7620.00	334.6	-2536.5	4328.5	896.00	0.564
	Winter	5	6724.00	3311.6	-3204.4	4996.4		
TS	Summer	5	60630.00	870.0	28085.5	29882.4	28984.00	*< 0.001
	Winter	5	31646.00	44.497	27904.4	30063.5		
TVS	Summer	5	3166.00	689.4	285.0	1750.9	1018.000	*0.013
	Winter	5	2148.00	172.8	172.9	1863.0		

Table 5. Demographic properties of participants in the survey

		Gender		Total
		Female	Male	
Degree being studied	Undergraduate	69	86	155
	Postgraduate	16	23	39
Total		85	109	194

Knowledge and Awareness about Dairy Product Environments

The present study included 194 student participant from Cyprus International University (**Table 5**). The majority of the students in the survey were undergraduate students which reflects the actual demography of the university. The number of males and females among all the study participants was comparable.

Figure 1 presents the level of the self-assessment dairy related environmental awareness among male and female participants. From the results, it is seen that 40 % of the female participants scored 2.75 or higher, while among the male participants, only 21% scored 2.75 or higher. The ANOVA (**Table 6**) indicates a similar finding where self-assessment among female students is significantly higher than the male students ($p = 0.023$).

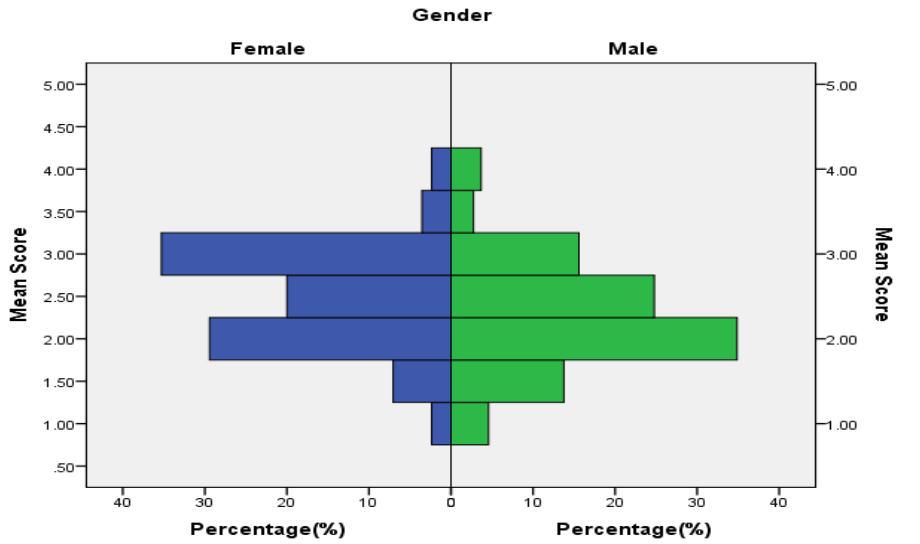

Figure 1. Dairy industry related environmental awareness with respect to gender

Table 6. The impact of Gender on dairy related environmental awareness

		Statistics			ANOVA	
		Number of people	Mean	SD	Mean Difference	*p* value
Gender	Female	85	3,40	0.51	0.18	0.023
	Male	109	3,22	0.54		

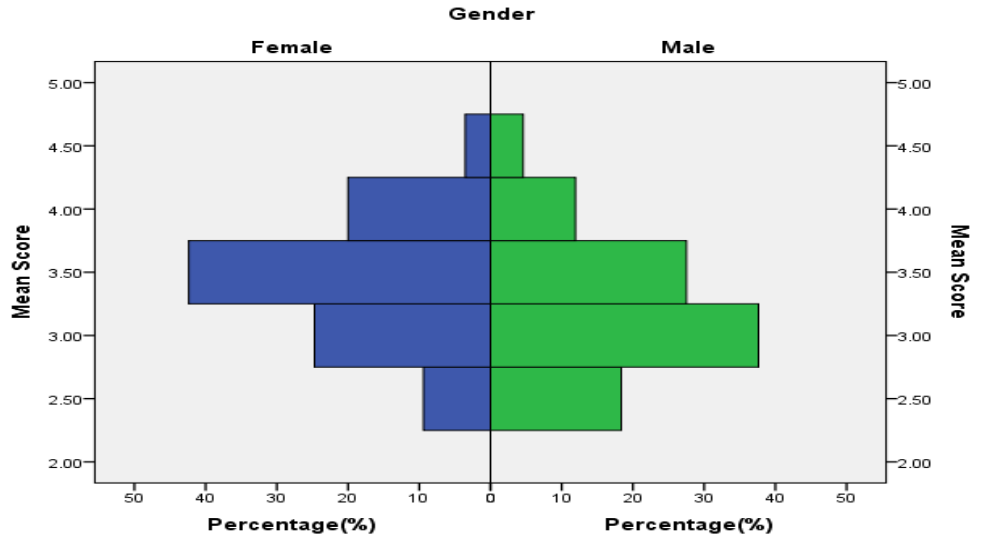

Figure 2. General environmental awareness with respect to gender

Table 7. The impact of gender general environmental awareness

		Statistics			Anova	
		Number of people	Mean	SD	Mean Difference	p value
Gender	Female	85	2,48	0.5	0.021	*< 0.001
	Male	109	2,27	1.1		

On the general environmental awareness (**Figure 2**), 64% of female participants scored 2.75 or higher while the rate of male students' participants who scored 2.75 or higher is limited to 44 %. ANOVA (**Table 7**) test also revealed significant difference ($p < 0.001$) between female and male participants.

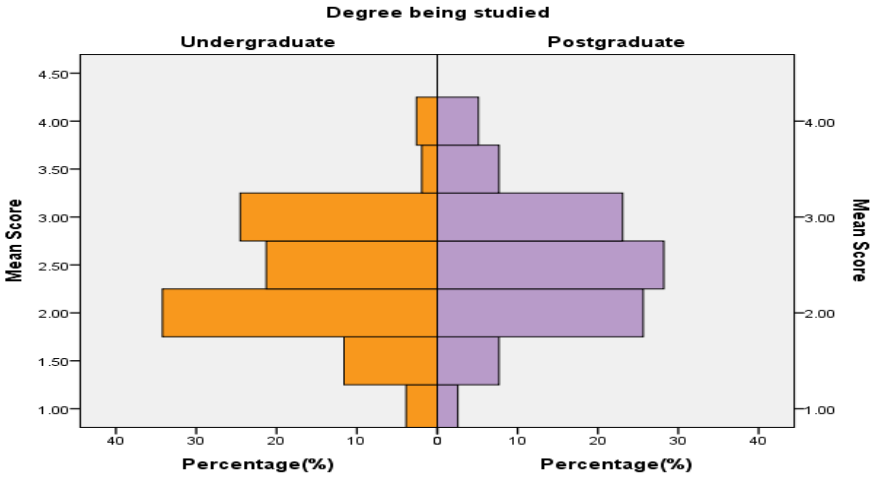

Figure 3. Dairy industry related environmental awareness with respect to studied degree

Table 8. The impact of studied degree on dairy related environmental awareness

		Statistics			Anova	
		Number of people	Mean	SD	Mean Difference	*p* value
Degree	Undergraduate	155	2,33	0.55	-0.19	* 0.034
	Postgraduate	39	2,52	0.54		

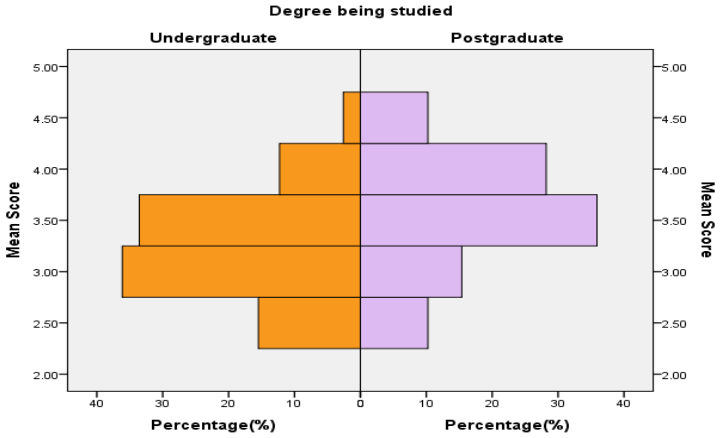

Figure 4. Dairy industry related environmental awareness with respect to studied degree

Table 9. The impact of studied degree on general environmental awareness

		Statistics			Anova	
		Number of people	Mean	SD	Mean Difference	*p* value
Degree	Undergraduate	155	3,23	0.50	-0.31	* 0.004
	Postgraduate	39	3,54	0.70		

The study also investigated the possible impact of studied degree on dairy related environmental awareness and general environmental awareness. For dairy related environmental awareness (**Figure 3**), only minority of undergraduate and postgraduate students scored above 2.75 (29% and 33%, respectively). However, ANOVA test (**Table 8**) revealed that there is statistical difference in favor of postgraduate students with respect to undergraduate students ($p = 0.034$). The statistical difference is likely to depend on the differing distributions of the students who scored below 2.75.

For general environmental awareness (**Figure 4**), 48% out of the undergraduate participants scored 2.75 or higher, while 76% out of postgraduates participants scored 2.75 or higher. Parallelly, there is significant difference between undergraduate and postgraduate students in the ANOVA test (**Table 9**).

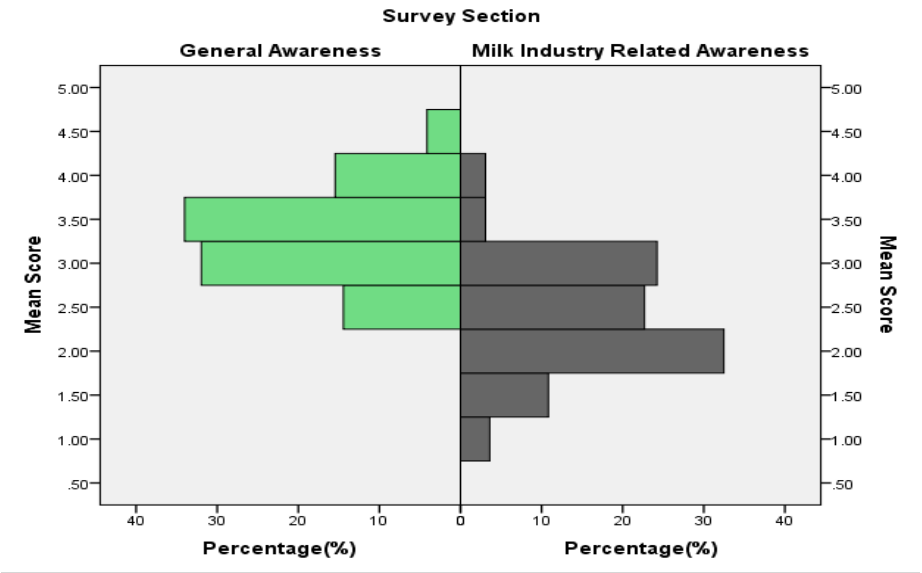

Figure 5. Comparison between the survey types

Table 10. Comparison of dairy related and general environmental awareness

		Statistics			Dependent *t* – test	
		Samples	Mean	SD	Mean Difference	*p* value
Question type	Dairy	194	2.36	0.53	-1.04	*0.001
	General	194	3.30	0.61		

Lastly, the self-assessment of student's in general environmental awareness and dairy industry related awareness was directly compared. **Figure 5** illustrates that although 85% of the students scored 2.75 or higher in general environmental awareness, the ratio dramatically decreased to 29% for dairy related environmental awareness. The dependent t-test verifies this finding ($p < 0.001$).

DISCUSSION

The study comprised two parts; the first part dealing with effluent characteristics analysis and the second part involving determination of consciousness and awareness of students in Cyprus International University about dairy industry related environmental and general environmental issues.

The first part of the study involved obtaining wastewater samples from a dairy factory and statistically analyzing effluent characteristics such as temperature, pH, COD, EC, turbidity, nitrile, nitrate, sulfate, phosphate, TDS, TSS, TS and TVS.

The temperature of wastewater is a significant indicator of a chemical process and helps to analyze the rate of the reactions, aquatic animals, and the fitness of the water. The optimal temperature for operation of secondary wastewater treatment facilities is approximately 25 °C. The effect of temperature on living organisms, specifically plants, is a great concern because is a primary factor that affects rate of plant growth (Jerry et al., 2015; Deepak S., 2014). The mean temperatures measured in winter and summer were 22 °C and 28 °C, similar to the findings in Britz et al. (2016). Between during winter and summer which in conformity with result obtained by observed temperature of waste water had a general conformity with atmospheric temperature; hence higher temperature was recorded in the summer months and lower in the winter months. The overall mean pH value was between 4 and 5, which is an acidic pH. Acidity of the sample may be attributed to decomposition of lactose in lactic acid under aerobic conditions which might cause corrosion of sewer if not justified to standard range of pH (6,5-8,5) before discharging the wastewater to the public sewer. Rusten et al. reported that pH range between 2 and 12 in cheese factory wastewater during winter. However, the standard deviation was high (1996). pH also gives implications about the concentration of carbonate, bicarbonate and CO_2 in wastewater (Abdel-Raouf et al., 2012). COD is used to measure organic strength in wastewater and indicates the activeness of huge heavy load of organic matters. Both white cheese and halloumi COD measurements were higher than the standard value guide line (250 mg/l). Halloumi vs white cheese during summer showed significant difference and that of winter shows highly significant difference ($p > 0.001$; n ≥5). According to the study Rusten et al., the COD value was found 20000 mg/L

during winter which is higher than the measurements in this study. However, in another study conducted by Monroy et al., during summer season they found COD concentration as 4430 mg/L which is lower than our results (10844 mg/L). In another study, Kavitha et al., found that the value of COD in January was higher than that of June. The same situation has been observed in our results for white cheese. Similar to the related studies, COD level differs for Halloumi. Total dissolved solid values were varying from 21914 to 49844 ppm in dairy waste water samples. High TDS concentration was possibly due to greater input of dissolved solids in water, while the minimum TDS value was noted in the winter season due to lower dissolution of solids in water in lower temperature. Similarly, Takariha and Sahu showed that TDS values reached the lowest value during November and December (2014). The observed EC values are higher than the EPA standard which indicates the electric charges present in the wastewater. The Nitrite ion (NO^{-2}), Nitrate ion (NO^{-3}) and Sulfate ion (SO_2^{-4}) were also analyzed and higher values than the EPA standard were measured. Both types of cheese variety showed a random fluctuation due to the potential difference of oxidation - reduction of the waste water. It has been observed that where there are both seasonal and variety dependent changes higher values are obtained due to the higher oxidation rate, while lower values are obtained due to the decrease of the oxygen. Phosphate ion immensely contribute to the nutrient load which can be very difficult to be removed from wastewater and in some cases it facilitates eutrophication when discharged to the environment as sewage. Majority of phosphate ion level in wastewater result from the phosphoric acid that are used by dairy factories for cleaning and the level can be reduced by using other cleaning materials. In our study, the seasonal change and the variation of the cheese variety did not affect the phosphate values. Unlikely, Takariha and Sahu reported that the total phosphate value shows a random monthly change probably because of phosphate flow differences.

According to EPA, the Mediterranean region wastewater TSS allowable limit is between 30-50 depending on country but in our study we found different values with respect to dairy product wastewater, the TSS value for Halloumi is around 3400 and that of white cheese is 6724. In a study done by Monroy et al., TSS value was found to be 1100. When we compare our values with literature, we can reach the conclusion that the expected limit range can be reached after wastewater treatment.

Due to high amount of effluents in dairy wastewater streams, there is need for the dairy industries to apply discharge regulation to reduce the effluents concentration to a level that is not harmful to living organism before discharging it into the municipal stream (Hemming, 1981). It is also necessary to improve the awareness about the possible environmental hazards of dairy industry by employing a well-planned educational policy. The second segment of this study investigated the general and dairy related environmental awareness among student attending Cyprus International University. Findings from this study showed the awareness of participants about the general environmental and dairy industry related environmental issues. The results revealed that female participants are more aware about the dairy product environment than the male participants and this may be attributed to sensitiveness of females with the environment as reported by Gabriella (2012). Similarly, Kumari et al. (2012), suggested that women had more attitude towards general environmental problems and they were consistent with other countries as in other studies. The reason for this may be that women are aware of environmental problems and individual responsibilities (Larijani, 2010). Some past studies on general environment revealed that, gender, income and other life experience have an effect on environmental awareness (Milfont et al., 2006; Xiao and Dunlap, 2007). Another study on gender environmental awareness showed that women are more aware about environment because they are directly related uncovered to the negative effects environmental dreadful conditions (Schultz et al., 2001).

The level of the studied degree was also analyzed in the study. The results indicate that when compared to undergraduate students, significantly greater proportion of the postgraduate students declared that they are aware of the general environmental issues. Similarly, the analysis the dairy related environmental survey revealed that, postgraduate students have more awareness than the undergraduate students. It has been reported previously that educational attainment, political orientation and age play significant role on behavior and environmental awareness (Van Liere and Dunlap, 1980; Jones and Dunlap, 1992; Guagnano and Markee, 1995; Milfont et al., 2006; Xiao and Dunlap, 2007). Moreover, our study showed that postgraduates' student possessed positive attitudes towards both environmental issues and dairy related environmental (Abbas and Singh, 2014). In other words, the results obtained from the study, students were already aware of their environment and implies that they have information about their environment. At the same time, the study emphasized that work is directly related to high environmental awareness, good attitudes towards the environment and greater sense of responsibility.

Social media and television were found to be the most important sources of information for students. Therefore, there is need to introduce environmental health education to undergraduate student's curriculum and it will play significant role towards preventing the students from the diseases that may happened as a result of dairy waste water and other environmental hazards.

CONCLUSION AND RECOMMENDATIONS

Dairy factory wastewater has high wastewater concentration that spreads around the TRNC and poses a danger to living organisms and can cause considerable diseases. The study has highlighted the composition and characteristics of the components of both halloumi and white cheese. Chemical property information such as pH, nitrogen, potassium and micronutrients in solid wastes are important in assessing processing and recovery options. It was found that both seasonal and variety related patterns play a role in the chemical output of the dairy production.

After the chemical content has been determined, dairy products awareness and general environmental awareness have been researched. According to our results, majority of the students are not informed about the content of dairy factory wastewater. It should be emphasized that more male students with respect to female students and more undergraduate students with respect to postgraduate students reported lack of common and dairy industry related environmental awareness. Therefore, teachers, health educators and media professionals should take responsibility to create awareness and to educate the public more especially students about the health effect of dairy factory wastewater and the entire environment. There is need to include environmental health education into the undergraduate's curriculum to increase awareness among students and the public. Furthermore the contents of the courses should include global issues, extracurricular activities and other activities that might change their environmental attitudes and behavior. The course should not only create awareness but change the way the student think about the environment they are living. In the creation of sustainable societies, the role of higher education institutions in this area needs to be strengthened and supported, taking into account the need for individuals in the society to have sufficient knowledge, skills and attitudes. Workshops and seminars regarding environmental issues like environmental health, environmental degradation and global warming should be carried out to create more awareness.

REFERENCES

Abbas, M. Y., & Singh, R. (2014). A Survey of Environmental Awareness, Attitude, and Participation amongst University Students: A Case Study, *International Journal of Science and Research*, *3*(5), 1755-1760.

Abdel-Raouf, N., Al-Homaidan, A., & Ibrahim B. (2012). Microalgae and wastewater treatment. *Saudi Journal of Biological Sciences*, *19*(3), 257-275.

Alichanidis, E., & Polychroniadou, A. (2009). Characteristics of major traditional regional cheese varieties of East Mediterranean countries: a review. *Dairy Science & Technology*, *88*, 495-510.

American Public Health Association (APHA). (1995). *Standard Methods for Estimation of Water and Wastewater* (19th ed.). Washington: American Water Works Association, Water Environment Federation.

Anja, S., Claire, B., Paul, V., & Leonardo, C. (2017). Interfacial properties of whey protein and whey protein hydrolysates and their influence on O/W emulsion stability. *Food Hydrocolloid, 73*, 129 -140.

Britz, T. J., & Corne, V. S. (2006). *Treatment of Dairy Processing Wastewaters*, Taylor & Francis Group, LLC.

Büyüköztürk, Ş. (2008). *Bilimsel Araştırma Yöntemleri* 1. Ed., Ankara: Pegema Yayıncılık.

Çabuk, B., & Karacaoğlu, C. (2003). Üniversite öğrencilerinin çevre duyarlılıklarının incelenmesi. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi*, *36*(1-2), 189-198.

Carawan, R. E., Jones, V. A., & Hanseen, A. P. (1979). Waste water characterization in a Multiproduct Dairy. *Journal of Dairy Science*, *62*(8), 1243-1251.

Ceritli, İ. (2001). Çevreci Hareketin Siyasallaşma Süreci. *Cumhuriyet Üniversitesi Sosyal Bilimler Dergisi*, *25*(2), 213-226.

Deepak, S. (2014). Treatment of dairy waste water by electro coagulation using aluminum electrodes and settling, filtration studies. *International Journal of ChemTech Research*, *6*(1), 591-599.

Demirel, B., Yenigun O., & Onay, T. T. (2005). Anaerobic treatment of dairy wastewaters: a review. *Process Biochemistry*, *40*(8), 2583-2595.

Fateema, C., Ana, R. P., & Javier R. (2013). Cheese whey wastewater: Characterization and treatment. *Science of the Total Environment,* 445-446, 385-396.

Gabriella, Y. C. (2012). Framing Water, Sanitation, and Hygiene Needs Among Female-Headed Households in Periurban Maputo, Mozambique. *American Journal of Public Health*, (12), 102.

Guagnano, G. A., & Markee, N. (1995). Regional differences in the sociodemographic determinants of environmental concern. *Population and Environment*, *17*, 135-149.

Gündüz, Ş., Erbulut, C., Öznacar, B., & Baştaş, M. (2016). Determination of consciousness and awareness of the public in Lefka about the Cyprus Mining Corporation (CMC), *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(4), 783-792.

Hem J. D. (1985). *Study and Interpretation of Chemical Characteristics of Natural Water'* (3rd ed). Washington: U.S. Geological Survey.

Hemming, M. L. (1981). The treatment of dairy wastes. In Herzka, A., & Booth, R. G. (Eds.) *Food Industry Wastes: Disposal and Recovery*. Essex: Applied Science Publishers Ltd**.**

Jerry, L., Hatfield, J., & Prueger, H. (2015). Temperature extremes: Effect on plant growth and development. *Weather and Climate Extremes*, 10A, 4 - 10.

Jones, R. E., & Dunlap, R. E. (1992). The social bases of environmental concern: Have they changed over time. *Rural Sociology*, *57*, 28-47.

Kaul, S. N., Mukherjee, P. K., Sirowala, T. A., Kulkarni, H., & Nandy, T. (1993). Performance evaluation of full scale waste water treatment facility for finished leather industry. *Journal of Environmental Science and Health*, (28), 1277-1286.

Kavitha, R. V., Kumar, S., Suresh, R., & Krishnamurthy, V. (2013). Performance Evaluation and Biological Treatment of Dairy Waste Water Treatment Plant by Up flow Anaerobic Sludge Blanket Reactor, *International Journal of Chemical & Petrochemical Technology*, *3*(1), 9-20.

Kolhe, A. S., & Pawar, V. P. (2011). Physico-chemical analysis of effluents from dairy industry, *Recent Research in Science and Technology*, *3*(5), 29-32.

Kumari, S., Gangwar, R. V., Singh, J., & Singh, A. P. (2012). Assessment of Environmental Awareness and Attitude among the School Teachers in Bareilly City", *International Journal of Innovative Research & Development*, *1*(8), 486-492.

Larijani, M. (2010). Assessment of Environmental Awareness among Higher Primary School Teachers", *Journal of Human Ecology*, *31*(2), 121-124.

Milfont, T. L., Duckitt, J., & Cameron, L. D. (2006). A cross-cultural study of environmental motive concerns and their implications for proenvironmental behavior. *Environment and Behavior*, *38*, 745-767.

Monroy, H. O., Va´zquez, M. F., Derramadero, J. C., & Guyot, J. P. (1995). Anaerobic-aerobic treatment of cheese wastewater with national technology in Mexico: the case of "El Sauz". *Water Science and Technology, 32*(12), 149–156.

Papademas, P., & Robinson, R. K. (1998). Halloumi cheese: the product and its characteristics. *International Journal of dairy technology*, *51*(3), 98-103.

Rahali, V., Chobert, J. M., Haertlé, T., & Guéguen, J. (2000). Emulsification of chemical and enzymatic hydrolysates of beta-lactoglobulin: Characterization of the peptides adsorbed at the interface. *Die Nahrung, 44*(2), 89-95.

Rainwater, F. H., & Thatcher, L. L. (1960). Methods for Collection and Analysis of Water Samples, U.S. Geol. Surv. *Water Supply Papers*, *1454*, 1-301.

Rusten, B., Siljudalen, J. G., & Strand, H. (1996). Upgrading of a biological-chemical treatment plant for cheese factory wastewater. *Water Science & Technology*, *43*(11), 41–49.

Schultz, I., Hummel, D., Empacher, C., Kluge, T., Lux, A., Schramm, E., Schubert, S., & Stiess, I. (2001). *Research on Gender, the Environment and Sustainable Development*. Frankfurt am Main: Institut für sozial-ökologische.

Tavakol, M., & Dennick R. (2011). Making sense of Cronbach's alpha, *International Journal of Medical Education*, (2), 53-55.

Tikariha, A., & Sahu, O. (2014). Study of Characteristics and Treatments of Dairy Industry Waste Water. *Journal of Applied & Environmental Microbiology*, *2*(1), 16-22.

Van Liere, K. D., & Dunlap, R. E. (1980). The social bases of environmental concern: A review of hypotheses, explanations and empirical evidence. *Public Opinion Quarterly*, *44*, 181-197.

Watkinsa M., & Nash D. (2010). Dairy Factory Wastewaters, Their Use on Land and Possible Environmental Impacts – A Mini Review. *The Open Agriculture Journal*, (4), 1-9.

Xiao, C., & Dunlap, R. E. (2007). Validating a comprehensive model of environmental concern cross-nationally: A U.S.-Canadian comparison. *Social Science Quarterly*, *88*, 471-493.