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The Impact of Municipal Wastewater on the Concentrations of Amino Acids in Polluted Water

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Abstract: *The study investigates the influence of sewage on water quality. Total organic carbon (TOC) and total nitrogen (TN) concentrations were the highest at the closest site to sewage discharge, indicating increased organic matter and nitrogenous compounds. Total protein (TPs) concentrations followed the same pattern as TN, further supporting the impact of sewage. Amino acid concentrations were significantly higher at the polluted site, suggesting their formation from decomposing organic matter by bacteria. Glycine and Arginine concentrations did not differ significantly across sites, indicating they may not be reliable indicators of water health. The study proposes using amino acid levels, especially those elevated at polluted sites, as indicators of water quality and organic load. Further research is recommended to investigate bacterial communities and their influence on amino acid diversity.*

.**Keywords:** *Amino acids, Kufa River, Municipal wastewater, Total nitrogen, Total protein, Total organic carbon*

1.Introduction

Municipal wastewater (MWW) is a major source of pollution in aquatic ecosystems [1]. It contains a variety of pollutants, including nutrients, heavy metals, and organic matter [2]. Amino acids are organic compounds that are essential for life [3]. They are found in all living organisms and are used to build proteins [4]. Amino acids are the building blocks of proteins, which are essential for all living organisms [5]. They are also important nutrients for aquatic plants and animals [6]. Municipal wastewater is a major source of amino acids in aquatic environments [7]. This wastewater can come from homes, businesses, and industries. It can contain high levels of organic matter, including amino acids [8].

The release of municipal wastewater into aquatic environments can have a significant impact on the concentrations of amino acids in the water [9]. This can lead to a number of environmental problems. The increase in the amount of nutrients in a body of water, it can lead to algal blooms (eutrophication), which can deplete oxygen levels in the water and harm aquatic life [10]. Some amino acids can be toxic to aquatic organisms, that concentrations of amino acids can also disrupt the balance of nutrients in an aquatic ecosystem [11]. Also, amino acids can leach into groundwater from contaminated soil or wastewater, this can pose a health risk to humans and animals [12].

A number of studies have investigated the impact of municipal wastewater on the concentrations of amino acids in polluted water. These studies have found that municipal wastewater can significantly increase the concentrations of amino acids in the water. For example, one study found that the concentration of glutamic acid, an amino acid, was 10 times higher in wastewater-contaminated water than in uncontaminated water [13].

The impact of municipal wastewater on amino acid concentrations can vary depending on a number of factors [14]. Wastewater from different sources can contain different concentrations of amino acids [15]. The more wastewater that is released into an aquatic environment, the greater the impact on amino acid concentrations [16]. The type of water body, such as a river, lake, or estuary, can affect the rate at which amino acids are removed from the water [17].

The diagnosis of dissolved amino acids in freshwater is an important tool for understanding the health of aquatic ecosystems [18]. By measuring amino acid concentrations, scientists can identify sources of pollution and track changes in water quality over time [19]. This information can be used to develop effective management strategies to protect aquatic ecosystems, once the amino acid concentrations have been measured, they can be used to diagnose the source of the amino acids [19]. For example, high concentrations of glutamic acid may be indicative of sewage contamination, while high concentrations of glycine may be indicative of algal blooms[20], so this study comes to investigate the types and concentrations of some amino acids in Euphrates River and how municipal wastewater affected them concentrations.

2.Methodology

To reaches the goals of current study, three station a long Kufa River were chosen (Fig. 1), Sextuplicate of water samples were collection during (Jul – 2022). Dissolved free amino acids (DFAA) were analyzed by using HPLC (UV/Vis, fluorescence; Benson and Haare 1975)[21]., and comparison with known amounts of authentic standards (Sigma). Also, total organic carbons (TOC), total nitrogen (TN), and total proteins (TP) depend on APHA were estimated[22].

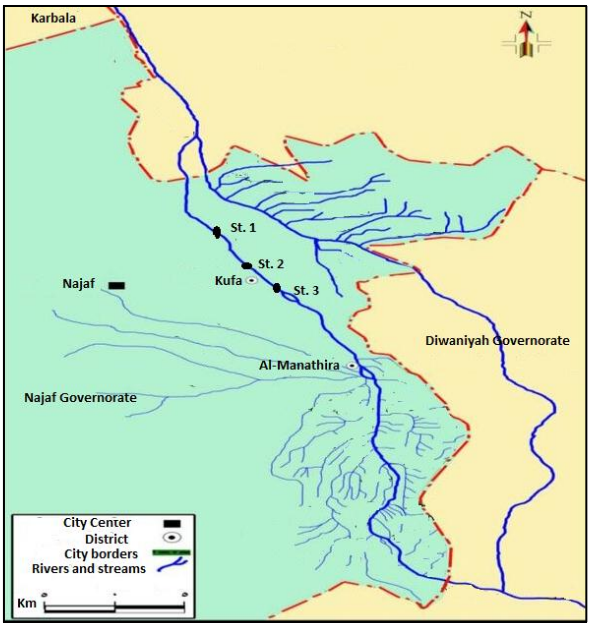

Fig. 1 the study sites (St.1 was near Kufa dam, St.2 near Old Kufa Bridge, St.3 after Municipal waste water effluents of Najaf city).

Results and discussions

Table 1 showed the results obtained from this work. Regarding total organic carbon, the study recorded a highly significant difference between the sites, as it was found that the first site had the lowest concentrations (1.400 ± 0.099 mg/L), followed by the second site (3.433±0.464 mg/L), then the third (9.233± 0.249 mg/L), as the second site is affected by human activities, presence of restaurants, which leads to throw waste into the river, this in turn increase the concentrations of total organic matter. The third site also recorded the highest concentrations because of its impact on sewage flows, which are about 500 meters away from the locations of the releases ,and this result is consistent with the findings of Al-Hadiary [23].

As for the concentrations of TN, it was noted that its concentrations behave the same way as TOC (Table. 1) with high significant changing, as it was recorded highest concentrations in the third site (11.06±0.907) and lower concentrations in the first site (2.677±0.242). The reason for this may be due to the releases coming from the sewage discharge at the third site containing a large amount of organic load. These materials contain high concentrations of nitrogenous compounds, which is one of the main characteristics of municipal sewage that must be treated.

The concentration of total nitrogen in water is considered a good indicator of total proteins, so the study recorded that the concentrations of TPs rise and decline with the concentrations of total nitrogen, the mean of TPs were (0.300±0.014, 1.173±0.137, and 2.333± 0.290) mg/L in the first, second, and third sites respectively.

For amino acids, the Glycine concentrations doesn’t differ significantly among the study sites, that concentrations were (10.027±0.391, 11.550±0.841 and 10.053±0.612) Mol% in St.1, St.2 and St.3 respectively (Table, 2). Also for Arginine, the concentrations doesn’t differ significantly, while all of other amino acids were differ significantly, and the highest concentrations were recorded at St.3, and the lowest values were at St.1. This means that the concentration of amino acids is directly affected by sewage water because sewage contains high concentrations of organic materials, nitrogen, and proteins, which means that there is a large activity of bacteria decomposing these materials, which ultimately leads to the formation of amino acids and their excretion in this site [24]. As for the second site, it is less polluted with organic materials, as is clear from the results, and it contains smaller amounts of nitrogen and proteins. Amino acids are less concentrated than the third site, and the same goes for the first site, which is clear from the results that the organic load is lower than the rest of the sites. As show in Table (3) the correlation among all of amino acids were strong except Glycine and Arginine, so they are not indicator for water health [25].

So this study suggest that the level of amino acids be taken as an indicator of the health of the water and the organic load, specifically the acids whose concentrations were highest at the third site. It is necessary to conduct deeper studies in this field and include a study of the composition of bacterial communities and their effect on the diversity of amino acids.

Conclusion

The release of municipal wastewater into aquatic environments can have a significant impact on the concentrations of amino acids in the water. This can lead to a number of environmental problems. It is important to develop and implement effective wastewater treatment strategies to reduce the release of amino acids into the environment.

Table 1. TOC, TN, and TP concentrations (mg/L)

Variables	Units	df	St.1		St.2		St.3		F	Sig	LSD
			Mean	SD	Mean	SD	Mean	SD			
TOC	mg/L	5	1.400	0.099	3.433	0.464	9.233	0.249	345.000	<0.01*	0.644
TN	mg/L	5	2.677	0.242	4.593	0.756	11.060	0.907	79.599	<0.01*	1.448
TP	mg/L	5	0.300	0.014	1.173	0.137	2.333	0.290	60.412	<0.01*	0.387

Table 2. The concentration of studied amino acids (Mol%)

Variables	Units	df	St.1		St.2		St.3		F	Sig	LSD
			Mean	SD	Mean	SD	Mean	SD			
Glycine	Mol%	5	10.027	0.391	11.550	0.841	10.053	0.612	3.694	0.090	1.334
Aspartic acid	Mol%	5	6.037	0.678	7.213	0.170	**8.557**	0.802	8.437	0.018*	1.277
Alanine	Mol%	4	1.837	0.045	2.003	0.353	4.037	2.567	37.013	<0.01*	1.107
Glutamic acid	Mol%	5	3.563	0.474	4.903	0.130	10.270	0.529	144.955	<0.01*	0.362
Serine	Mol%	5	2.037	0.316	3.213	0.236	4.557	0.318	49.225	<0.01*	0.608
Valine	Mol%	4	2.370	1.041	4.880	0.374	6.973	0.568	20.604	0.002*	1.493
Leucine	Mol%	5	1.370	0.225	2.213	0.704	3.307	0.223	9.496	0.014*	0.927
Threonine	Mol%	4	4.563	0.474	5.570	0.410	9.270	0.668	43.920	<0.01*	1.101
Arginine	Mol%	5	0.370	0.225	0.880	0.374	0.973	0.264	2.432	0.168	0.612
Isoleucine	Mol%	3	1.703	0.293	2.547	0.309	3.890	0.245	30.182	0.001*	0.591
Phenylalanin	Mol%	5	2.103	0.134	3.747	0.330	6.223	0.359	100.816	<0.01*	0.608
Tyrosine	Mol%	3	2.073	0.062	3.180	0.082	6.023	0.033	2139.000	<0.01*	0.132
Methionine	Mol%	5	2.027	0.391	3.583	0.331	4.387	0.146	30.466	0.001*	0.640
Histidine	Mol%	4	1.677	0.242	2.927	0.502	4.393	0.075	35.033	<0.01*	0.675

Table 3. The correlations among the studied variables

	TOC	TN	TP	GLI	ASP	ALA	GLU	SER	VAL	LEU	THER	ARG	ISOL	PHEN	TRY	METH
TN	0.976	1.000														
TP	0.951	0.968	1.000													
GLI	**-0.159**	**-0.272**	**-0.143**	1.000												
ASP	0.831	0.768	0.760	0.015	1.000											
ALA	0.831	0.768	0.760	0.015	1.000	1.000										
GLU	0.982	0.958	0.917	-0.194	0.863	0.863	1.000									
SER	0.831	0.768	0.760	0.015	1.000	1.000	0.863	1.000								
VAL	0.878	0.877	0.901	-0.056	0.926	0.926	0.867	0.926	1.000							
LEU	0.879	0.824	0.803	0.194	0.825	0.825	0.847	0.825	0.841	1.000						
THER	0.979	0.955	0.907	-0.168	0.845	0.845	0.970	0.845	0.869	0.882	1.000					
ARG	**0.482**	**0.579**	**0.685**	**-0.103**	**0.475**	**0.475**	**0.492**	**0.475**	**0.691**	**0.406**	**0.410**	1.000				
ISOL	0.939	0.932	0.937	0.015	0.723	0.723	0.910	0.723	0.819	0.876	0.876	0.572	1.000			
PHEN	0.976	0.933	0.930	0.027	0.872	0.872	0.960	0.872	0.896	0.916	0.945	0.489	0.957	1.000		
TRY	0.976	0.933	0.930	0.027	0.872	0.872	0.960	0.872	0.896	0.916	0.945	0.489	0.957	1.000	1.000	
METH	0.865	0.791	0.869	0.245	0.786	0.786	0.831	0.786	0.807	0.794	0.821	0.449	0.862	0.922	0.922	1.000
HIS	0.936	0.885	0.915	-0.049	0.851	0.851	0.898	0.851	0.886	0.808	0.877	0.485	0.886	0.951	0.951	0.923

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