

Removal Techniques of Nitrate from Water by Duckweeds (*Spirodela polyrhiza*)

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Abstract

The increasing of use chemical fertilizer causing increase nitrate concentration in irrigation water; this study came to reduce nitrate level in irrigation water to get safe agricultural products. The growth performance of duckweeds (*Spirodela polyrhiza*) and its removal of nitrate in reclaimed water taken from king TALA dam in Jordan with deferent process were studied. The experiments were conducted in an environmentally controlled growth chamber in Jordan valley authority laboratories.

Objectives of this study were to analyses nitrate in agricultural growth media contain nitrate concentration 5.0 ppm, 10.0 ppm and 20.0 ppm which covered by duckweeds (*Spirodela polyrhiza*) and other media contain only nitrate standard 5.0 ppm, 10.0 ppm and 20.0 ppm without duckweed.

All Growth media were analyzed by using spectrophotometer technique at wave length 220 nm by taking different samples of growth media contain nitrate only, and other growth media contain nitrate with duckweeds (*Spirodela polyrhiza*).

Compared with the treatments without duckweed the concentration of nitrate concentration were reduce 46% in growth media (1) nitrate concentration were reduce 44% in growth media (2), and nitrate concentration were reduce 41% in growth media (3).

Keywords: Nitrate; *Spirodela polyrhiza*; Duckweed

Introduction

More than 70% of the area is covered by water. Therefore, apparently it seems that is abundant with water. however, availability of fresh water is anger problem across the world. The negative activities that cause the degradation of fresh water can be categorized into five types, such as point contamination sources, diffuse contamination sources, ground water over exploitation, artificial recharge and seawater intrusion.

Nitrate pollution of irrigation water is a major environmental problem all over the world.

Nitrate transfer by plant root and accumulate in fruit and plant tissues. Nitrate is itself non-toxic to humans and livestock however; its toxic metabolites, such as nitrite (NO₂⁻) and later product such as N-nitroso compounds, are thought to be deleterious to health (Mensinga., et al. 2003) (e.g. nitrites react with haemoglobin and produce methemoglobin, which enables to transport of oxygen at the cellular level). Consequently, numerous techniques have been developed to remove or reduction of nitrate in water. A review of removal techniques of nitrate from water has been carried out in this paper by using duckweeds (*Spirodela polyrhiza*).

Recent literatures related to various techniques including reverse osmosis, ion exchange, electro dialysis, biological de-nitrification, chemical de-nitrification, adsorption methods using different adsorbents like carbon base, agricultural waste, natural

materials are systematically review to assess their performance. The paper reveals that adsorption could be the most promising technique of removal of nitrate from water in near future.

The *lemnaceae*, commonly called duckweed, scientific name *Spirodela polyrhiza*, is an aquatic plant that can be used to recover the surface water to absorbed soluble nitrate form water before use it for irrigation.

Figure 1

Sample collection

To prepared agricultural growth media we collect duckweeds (*Spirodela polyrhiza*) from lake in farm located in Jordan- Jordan

valley area with demand area 22 and farm unit 189 then let it grow in glass beaker with capacity one liter in Jordan valley laboratories after that we take 10 ml daily of solution to measure residual nitrate up to 10 days as in table 1.

Preparation of samples

Taken 3x 10 ml from every agricultural growth media through the time then filtered (using Whatman 15 filter paper), All samples were immediately analyzed within 1 hr after sample preparation.

Period time	Growth media 5.0 ppm		Growth media 10.0 ppm		Growth media 20.0 ppm	
	NO ₃		NO ₃		NO ₃	
	No duckweeds	With duckweeds	No duckweeds	With duckweeds	No duckweeds	With duckweeds
1 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
2 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
4 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
6 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
8 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample
10 day	3 sample	3 sample	3 sample	3 sample	3 sample	3 sample

Table 1: Growth medias.

Analytical equipment

Reading samples by using ultraviolet spectrophotometric screening method by spectrophotometer instrument type unicam at wavelength 220nm.

Preparation of reagents and standard solutions

All solutions were prepared in deionized (DI) water with a specific resistance of at least 18 MΩ-cm (Millipore, Billerica, MA, USA). All reagents were ACS grade.

Working standards were 1, 5, 15 and 20 µg/mL-1 prepared from diluting standard reference material (Accustandard/aqueous solution) containing 100 µg/mL-1 nitrate standards in deionized water milliQ. These calibration standards were replaced daily.

Result and Discussion

Analysis result show decreasing in nitrate concentration in all agricultural growth medias due to absorption by duckweeds (*Spirodela polyrhiza*) nitrate concentration in growth media (1) is decreased from 4.98 mg/l to 2.68 mg/l after 10 days as show in table 2.

period time	NO ₃ (mg/l) level	
	No duckweeds	With duckweeds
1 day	5.1	4.98
2 day	5.1	4.72
4 day	54.98	4.21
6 day	4.95	3.56
8 day	4.95	3.19
10 day	4.94	2.68

Table 2: Nitrate concentration in growth media (1) 5.0 mg/l -nitrate.

Nitrate concentration in growth media (2) is decreased from 9.89 mg/l to 5.58 mg/l after 10 days as show in table 3.

Period time	NO ₃ (mg/l) level	
	No duckweeds	With duckweeds
1 day	10	9.89
2 day	10.1	9.14
4 day	10.1	8.65
6 day	9.97	7.58
8 day	9.94	6.7
10 day	9.9	5.58

Table 3: Nitrate concentration in growth media (2) 10.0 mg/l – nitrate.

Nitrate concentration in growth media (3) decrease from 19.95 ppm to 11.68 mg/l after 10 days show in table 4.

Period time	NO ₃ (mg/l) level	
	No duckweeds	With duckweeds
1 day	20.2	19.95
2 day	20.1	18.22
4 day	19.88	16.53
6 day	19.85	15.07
8 day	19.84	13.29
10 day	19.82	11.69

Table 4: Nitrate concentration in growth media (3) 20.0 mg/l -nitrate.

Conclusion

The study shows decreasing in nitrate level in prepared growth of duckweeds (*Spirodela polyrhiza*) by using spectrophotometer at wavelength 220 nm.

Normally, The higher concentration of nitrate in irrigation water is toxic for most of plant and Indirectly For human health.

In this study we prepared growth medias contain different levels of nitrate by using 1000ml of local irrigation water in Jor-

dan valley for every media and covered this medias by duckweeds (*Spirodela polyrhiza*) to remove nitrate from water by preparation three beakers of growth medias, agricultural growth media (1) contain 5.0 mg/l nitrate, agricultural growth media (2) contain 10.0 mg/l nitrate and agricultural growth media (3) contain 20.0 mg/l nitrate, after 10 days we found the absorption nitrate percent by duckweeds (*Spirodela polyrhiza*), agricultural growth media (1) absorbed 46.0% of nitrate, agricultural growth media (2) absorbed 44.% of nitrate and agricultural growth media (3) absorbed 41.0% of nitrate.

This study stress on the needs to train and educate farmers and advise them to observe good agriculture practice (GAP) to minimize nitrate concentrations in vegetables and fruits, by using biotechnic as using duckweeds (*Spirodela polyrhiza*) [1-16].

Bibliography

- Alaerts GJ., *et al.* "Performance of a full-scale duckweed-covered sewage lagoon". *Water Research* 30 (1996): 843-852.
- Cheng JJ and Stomp AM. "Growing duckweed to recover nutrients from wastewaters and for production of fuel ethanol and animal feed". *Clean Soil Air Water* (2009).
- Cheng J., *et al.* "Nutrient recovery from swine lagoon water by *Spirodela punctata*". *Bioresource Technology* 81 (2002): 81-85.
- Xu JL and Shen GX. "Growing duckweed in swine wastewater for nutrient recovery and biomass production". *Bioresource Technology* 102 (2011): 848-853.
- S Islam and MT Suidan. "Electrolytic denitrification: Long term performance and effect of current intensity". *Water Research* 32 (1998): 528.
- M Shrimali and KP Singh. "New methods of nitrate removal from water". *Environmental Pollution* 112 (2001): 351-359.
- HA Hanafi and SMA. Azeema. "Removal of Nitrate and Nitrite Anions from Wastewater Using Activated Carbon derived from rice straw". *Journal of Environmental and Analytical Toxicology* (2016).
- "EPA quality criteria of water us environmental protections authority". Washington. D.C USA (1986).
- Z Jiang., *et al.* *Water research* – Elsevier (2011).
- WHO. "Guidelines for Drinking Water quality recommendations". World Health Organization, Geneva 1 (1984).
- M Oldani., *et al.* "On the nitrate and monovalent cation selectivity of ion exchange membranes used in drinking water purification". *Journal of Membrane Science* Elsevier (1992).
- Azzeddine El Midaoui. "Optimization of nitrate removal operation from ground water by electrodialysis". *Separation and Purification Technology* (2002): 234-244.
- Gideon Oron., *et al.* "Nitrogen removal and conversion by duckweed grown on waste-water". *Water Research* 22 (1988): 179-184.
- Aloyce W Mayo. "Removal mechanisms of nitrogen in waste stabilization ponds". *Physics and Chemistry of the Earth, Parts A/B/C* 72 (2014): 77-82.
- Reed SC., *et al.* "Natural systems for waste management and treatment".
- Harun Böcük., *et al.* "Assessment of Lemna gibba L. (duckweed) as a potential ecological indicator for contaminated aquatic ecosystem by boron mine effluent". *Ecological Indicators* 29 (2013): 538-548.

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