Application of Pharmaceutical Wastewater in Planting French Marigold

Yu Wang¹, Zhidong Huang ²*

¹Department of Biomedical and Chemical Engineering, Liaoning Institute of Science and Technology, Benxi, Liaoning, 117004, China
²Department of Mechanical Engineering, Liaoning Institute of Science and Technology, Benxi, Liaoning, 117004, China
*Corresponding author’s e-mail: 804209063@qq.com

Abstract. Based on biological method, the harmless treatment of pharmaceutical wastewater is achieved, which is applied to planting French marigold after suitable dilution. The protein content, vitamin C content and reducing sugar content of French marigold are determined with ultraviolet absorption method. The experiment results show that planting French marigold with pharmaceutical wastewater had no bad effect on French marigold, which facilitates reutilization of pharmaceutical wastewater.

1. Introduction
With the gradual rise of pharmaceutical enterprises in the pharmaceutical capital of China, a large number of nitrogen-containing pharmaceutical wastewater is also increasing. If directly discharged into the water body, it can lead to eutrophication of the water body, and cause harm to human beings and surrounding organisms [1-2]. At present, chemical method, logistics method and biological method [3-6] are often used to treat pharmaceutical wastewater at home and abroad, but most of the treated water is directly discharged into the surrounding water body, resulting in huge waste. In order to solve this problem, this paper uses biological methods to treat the pharmaceutical wastewater produced by pharmaceutical enterprises innocuously [7], which reduces its toxicity to organisms, and to dilute it properly, and then it is used in the planting of common French marigold in the pharmaceutical capital area, to regularly detect the protein content, vitamin C content and reducing sugar content of French marigold, and to observe the French marigold through data comparison. The experimental results show that the harmless treatment of pharmaceutical wastewater has no obvious adverse effect on the growth of French marigold, which can be used for the irrigation of this plant, so as to realize the valuable reuse of wastewater, and provide favorable experimental evidence for the secondary utilization of wastewater in the pharmaceutical capital area.

2. Material and method

2.1. Test material
French marigold belongs to Compositae and marigold. Its leaves are similar to grass. It can be harvested, used fresh or dried to cure diseases. It likes sunny places, has straight tubular flowers and strong adaptability to the environment. It was first found in Mexico. It is also distributed in southern China, such as Yunnan Province [8], as shown in Figure 1.
Harmless soil treatment: the soil used in this experiment is from mountain of Liaoning Institute of Science and Technology. The chemical oxygen demand (COD) is 6500, which is directly measured by COD rapid tester. COD decreased to 180 after the above-mentioned pharmaceutical wastewater was treated by biological method. In order to reduce the biological toxicity of the treated wastewater, it was diluted 10 times, 20 times and 40 times respectively and applied to the planting soil of French marigold.

2.2. Test method
Twelve pots of French marigold were divided into 4 groups. The wastewater was treated with tap water, diluted 10 times, diluted 20 times and diluted 40 times respectively. The protein content, reducing sugar content and vitamin C content were measured every 4 days.

2.2.1. Determination of protein content of French marigold. The protein content of French marigold was determined by ultraviolet absorption method. Select French marigold leaves, wash them clean, absorb water, weigh 0.1g accurately, add 3ml 0.9% NaCl solution to grind, constant volume to 10ml, centrifuge at 4℃ for 5min at 6000r / min, dilute 10 times, measure the absorbance at 280nm, make three parallel samples, take the average value. Take the absorbance value of the sample into the standard curve, check the protein content, and calculate the protein content according to the sample mass and its diluted volume.

2.2.2. Determination of vitamin C in French marigold. The content of vitamin C in French marigold was determined by ultraviolet absorption method. Select French marigold leaves, wash them clean, absorb water, weigh 0.1g accurately, add 3ml 2% metaphosphoric acid solution, dilute to 10ml after homogenization, centrifuge for 5min at 6000r / min at 4 ℃, dilute 10 times, take 2% metaphosphoric acid solution as control, measure the absorbance at 246nm, make three parallel samples, take the average value. Take the absorbance value of the sample into the standard curve, check the vitamin C content, and calculate the vitamin C content according to the sample mass and its diluted volume.

2.2.3. Determination of reducing sugar content of French marigold. 3,5-Dinitrosalicylic acid method was used to determine the reducing sugar content of French marigold. Weigh 0.10g of clean French marigold leaves, add distilled water to break them, keep them in a constant temperature water bath at 50 ℃ for 20min, prepare the reducing sugar extraction solution, take four test tubes, add 1.00mL of distilled water to the care tube, 1.00mL of the rest, add 2.00ml of DNS reagent, heat them in the boiling water bath for 5min, develop the color, take After leaving, cool it quickly with running water, add 9.00ml of distilled water into each, shake it well, measure the absorbance at 540nm, bring the
absorbance value of the sample into the standard curve, check the reducing sugar content, and calculate the reducing sugar content according to the formula.

2.3. Data analysis

The protein content of French marigold are determined as shown in Table 1.

|                               | Tap water (g / 100g) | 10 times (g / 100g) | 20 times (g / 100g) | 40 times (g / 100g) |
|-------------------------------|----------------------|---------------------|---------------------|---------------------|
| Zeroth days                   | 1.42                 | 1.42                | 1.42                | 1.42                |
| Fourth days                   | 1.61                 | 1.95                | 2.83                | 2.69                |
| Eighth days                   | 2.14                 | 3.09                | 3.79                | 3.34                |
| Twelfth days                  | 2.34                 | 3.52                | 4.10                | 3.91                |
| Sixteenth days                | 2.48                 | 3.57                | 4.24                | 3.95                |
| Twentieth days                | 3.39                 | 3.91                | 4.67                | 4.21                |

It can be seen from the protein content data of French marigold measured in Table 1 that the protein content of French marigold is also increasing with the increase of experimental days, and the protein content of French marigold is relatively high when it is cultivated with diluted 20 times of pharmaceutical wastewater.

The vitamin C content of French marigold are determined as shown in Table 2.

|                               | Tap water (mg / 100g) | 10 times (mg / 100g) | 20 times (mg / 100g) | 40 times (mg / 100g) |
|-------------------------------|-----------------------|----------------------|----------------------|----------------------|
| Zeroth days                   | 630.24                | 630.24               | 630.24               | 630.24               |
| Fourth days                   | 643.12                | 680.25               | 753.25               | 702.36               |
| Eighth days                   | 776.34                | 897.36               | 1095.67              | 914.32               |
| Twelfth days                  | 897.35                | 950.37               | 1137.68              | 987.28               |
| Sixteenth days                | 917.34                | 985.64               | 1197.56              | 1022.67              |
| Twentieth days                | 946.37                | 1003.24              | 1272.36              | 1024.35              |

It can be seen from the data of vitamin C content of French marigold determined in Table 2 that with the increase of experimental days, the vitamin C content of French marigold is also increasing, and the vitamin C content of French marigold is relatively high when it is cultivated with diluted 20 times pharmaceutical wastewater.

The reducing sugar content of French marigold are determined as shown in Table 3.

|                               | Tap water (100%) | 10 times (100%) | 20 times (100%) | 40 times (100%) |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|
| Zeroth days                   | 1.56            | 1.56            | 1.56            | 1.56            |
| Fourth days                   | 2.01            | 2.19            | 2.32            | 2.28            |
| Eighth days                   | 2.39            | 2.45            | 2.83            | 2.64            |
| Twelfth days                  | 2.6             | 2.81            | 3.38            | 3.12            |
Sixteenth days  |  3.08 |  3.33 |  3.73 |  3.12  
Twentieth days |  3.31 |  3.50 |  3.79 |  3.25 

It can be seen from the data of reducing sugar content of French marigold determined in Table 3 that the reducing sugar content of French marigold is also increasing with the increase of experimental days, and the reducing sugar content of French marigold is relatively high when it is cultivated with diluted 20 times pharmaceutical wastewater.

3. Results and analysis

3.1. Changes of protein content in French marigold
Based on Table 1, it can be concluded that the protein content of French marigold is significantly higher than that of the tap water control group when it is cultivated with diluted 10 times, diluted 20 times, diluted 40 times and treated waste water, among which the protein content of French marigold cultivated with diluted 20 times of treated pharmaceutical waste water is the most significant one. The analysis reason is that the pharmaceutical waste water contains a lot of nitrogen, carbon and less minerals. After harmless treatment of pharmaceutical wastewater, the molecular form of each element becomes smaller. After dilution, each element of pharmaceutical wastewater is more conducive to French marigold absorption. Nitrogen is the main element of protein synthesis in plants, so it will lead to significant increase of protein content.

3.2. Changes of vitamin C content in French marigold
Based on Table 2, it can be concluded that the vitamin C content of French marigold is significantly higher than that of tap water control group after the treatment of pharmaceutical wastewater with 10 times of dilution, 20 times of dilution and 40 times of dilution. The most significant increase is the vitamin C content of French marigold cultivated with 20 times of dilution. The analysis is due to the cellulose, hemicellulose and hemi-cellulose contained in pharmaceutical wastewater Carbon source, after harmless treatment, the molecular weight of carbon source decreased, which is more conducive to French marigold absorption, and carbon is the main element of vitamin C synthesis in plants, so it will lead to a significant increase of vitamin C content in French marigold.

3.3. Changes of reducing sugar content in French marigold
Based on Table 3, it can be concluded that the reducing sugar content of French marigold is significantly higher than that of tap water control group after the treatment of pharmaceutical wastewater with 10 times, 20 times and 40 times of dilution, and the reducing sugar content of French marigold cultivated with 20 times of dilution is the most significant. The analysis is that the pharmaceutical wastewater contains a large number of carbon sources, and the pharmaceutical wastewater is harmless. After treatment, the molecular weight of the carbon source decreased, which is more conducive to French marigold absorption. Carbon is the main element of reducing sugar synthesis in plants, so it will lead to a significant increase of reducing sugar content in French marigold.

4. Conclusion
Harmless treatment of wastewater from pharmaceutical enterprises can obviously promote the growth of French marigold, which can be used for planting and watering of this plant, so that the wastewater can realize the reuse of resources, and provide favorable experimental evidence for the secondary utilization of wastewater.

Acknowledgments
This work was financially supported by Scientific Research Project of Liaoning Province Education Department of China (L2019lkyqn-02), Innovation Talent Support Program for College and
Universities in Liaoning Province of China (LR2019036) and Ministry of education's Cooperative Education Project of China (201702082003).

References

[1] He, Y., Zhao, Y.C., Zhou, G.M. (2008) Research process on the denitrogenation of highly concentrated ammonium-nitrogen wastewater. Industrial Water Treatment, 28(1): 1-4.

[2] Li, Y.Q., Ma, J., Qian, G.E. (2009) Progress in the treatment technology of pharmaceutical wastewater. Industrial Water Treatment, 29(12): 5-7.

[3] Muhammad, S.A., Tasneem, A.A. (2010) Waste Water Treatment Using Sequential Batch Reactor and Development of Microbiological Method for the Analysis of Relative Toxicity. Pakistan Journal of Nutrition, 9(6): 574-576.

[4] Zhang, Y. (2012) UASB - two levels of pharmaceutical wastewater treatment engineering design and operation of A/O. Industrial water and wastewater, 43(1): 79-82.

[5] Jiang, R., Zeng, H.Y., Wang, Q. (2013) Research progress of ammonia nitrogen wastewater treatment technology. Environmental Science and Management, 38(6): 131-134.

[6] Cui, S.J., Gu, L.K., Zhang, J.Y., Lu, D.H., Liu, B.B. (2010) Treatment Technologies of high concentration ammonia nitrogen wastewater and their research and application status. China Water & Wastewater, 26(14): 26-29.

[7] Wu, L.H., Li, X.H., Yang, F., Wang, D. (2014) Screening and identification of a high performance denitrifying bacteria strain used in bio-augmentation process. Jiangsu agricultural Sciences, 42(12): 371-373.

[8] Yuan, Y.X. (2019) Effects of Hydrogen Peroxide on Flavonoid Content and Antioxidant Enzymes Activity of Suspension Cells of Tagetes patula L.. Northern Horticulture, 43(19): 55-59.