

EFFECT OF NON-DIGESTIBLE NANOPARTICLES ON ANIMALS' HEALTH AND BEHAVIOR

by

Tao JING and Yun-Yu LI*

School of Textile Science and Engineering, Xi'an Polytechnic University, Xi'an, China

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The effect of air quality on human's health has been extremely studied, nanoparticles in air can cause various diseases and even lead to death. However, the effect of non-digestible nanoparticles from food on physical and mental health has been seriously ignored, no report was seen in open literature. This paper uses silkworm as an experimental subject by feeding nanoparticles in food throughout their life, the results show that non-digestible nanoparticles can greatly change animal's body morphology, behavior and longevity. This paper gives an unprecedented warning on food safety and drinking water.

Key words: metabolic rate, host, virus, allometry, food packaging

Introduction

Due to the increasing air pollution, much attention has been paid to the effect of nanoparticles effect on human's health, and it has been concluded that nanoparticles in air can cause serious health problem and even lead to death [1-3]. Many strategies were appeared to control fine particulate matters with diameter less than 2.5 μm [4]. However the effect of non-digestible nanoparticles from food and drinking water on human health has never been studied, no literature was found so far. It is extremely urgent to have a systematical study the effect of nanoparticles on human's physical and mental health. To this end, an experiment was designed using silkworm as a sample, various nanoparticles were fed to check the animal's grow-up, behavior and life span.

Effect of non-digestible nanoparticles on metabolic rate

Generally the metabolic rate of an animal can be expressed [5-7]:

$$B \propto M^{3/4} \quad (1)$$

where B is the metabolic rate and M – organ mass.

When non-digestible nanoparticles are fed through food, the metabolism is stimulated, and eq. (1) can be modified:

$$B \propto M^{3/4+C} \quad (2)$$

where C is a coefficient reflecting the intake of the non-digestible nanoparticles.

* Corresponding author, e-mail: liyunyu@xpu.edu.cn

Longevity of the animal scales with:

$$L \propto M^{1/4-C} \quad (3)$$

where L is the life span. Equation (3) means a higher intake of nanoparticles leads to a lower life span.

Experimental verification

In our experiment, silkworm was raised from the newly-hatched stage to the fifth instar, CNT, graphene powders (GR), and silicon carbide nanowires (SiCnws) were used as additive in food. The nanoparticles were added to a solution with concentration of 1%, which was stirred until a homogeneous solution was obtained. The obtained solution was then sprayed uniformly on the mulberry leaves for feeding the animal.

The animal's body length was recorded at each instar as illustrated in fig. 1(a). It can be found that the nanoparticles greatly affected the animal's morphology. Figure 2(b) recorded the survival rate of the animal at each instar. It was found that the death rate at the initial stage was relatively low, but it increased remarkably at the late stages.

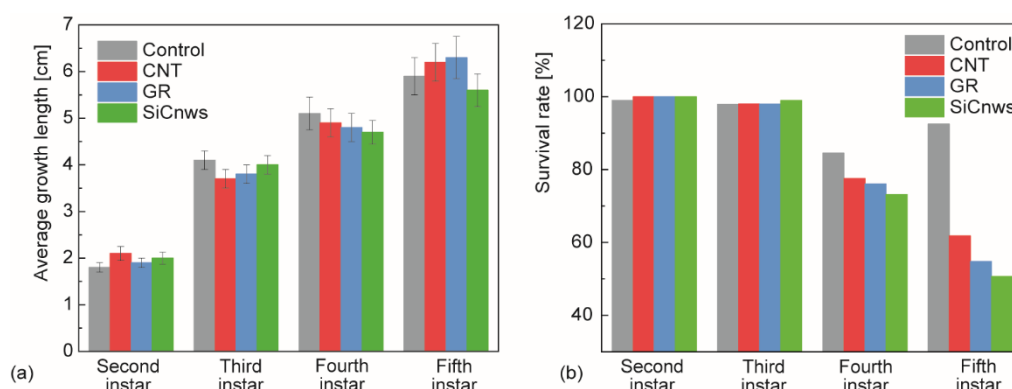


Figure 1. Effects of nanoparticles on silkworm's grow-up (a) and death rate (b)

We also observed the animal's strange behavior after feeding nanoparticles, that was twin cocoons were found in our experiment. Figure 2(a) was the probability of twin cocoon in each group. Silkworm cocoons obtained from different groups were shown in fig. 2(b). Figure 2(c) is the real picture of the twin cocoon.

Discussion and conclusions

As we can see clearly that the intake of nanoparticles will greatly affect the animal's metabolic rate, as a result, its grow-up is greatly affected, this can be seen the animal's body length change in fig. 1(a). As the increase of the total intake of nanoparticles, the death rate increases remarkably.

The animal's behavior is also greatly affected by the nanoparticles, the probability of twin cocoon due to CNT is highest, revealing the CNT are the most harmful to animal's behavior among all nanoparticles.

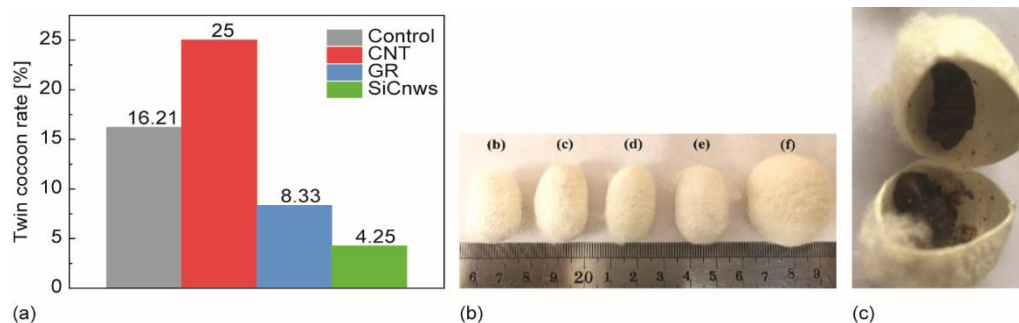


Figure 2. Twin cocoon; (a) the probability of twin cocoon in each group, (b) silk worm cocoons obtained from the control group, CNT group, GR group and SiCnws group, respectively, and (c) real picture of twin cocoon

This paper, for the first time ever, reveals the extremely important effect of non-digestible nanoparticles on animal's body morphology, behavior and longevity. This paper gives an unprecedented warning on food safety and drinking water safety.

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References

- [1] Gu, X. Y., *et al.*, Effects of PM_{2.5} Exposure on the Notch Signaling Pathway and Immune Imbalance in Chronic Obstructive Pulmonary Disease, *Environmental Pollution*, 226 (2017), July, pp. 163-173
- [2] Federico, T., *et al.*, Air Quality in the Olona Valley and In Vitro Human Health Effects, *Science of the Total Environment*, 579 (2017), 12, pp. 1929-1939
- [3] Fan, X. Y., *et al.*, More Obvious Air Pollution Impacts on Variations in Bacteria than Fungi and Their Co-Occurrences with Ammonia-Oxidizing Microorganisms in PM_{2.5}, *Environmental Pollution*, 251 (2019), Aug., pp. 668-680
- [4] Zhang, S., *et al.*, Experimental Study on Production and Emission Characteristics of PM_{2.5} from Industrial Fluidized Bed Boilers, *Thermal Science*, 24 (2020), 5A, pp. 2665-2675
- [5] West, G. B., *et al.*, A General Model for Origin of Allometric Scaling Laws in Biology, *Science*, 276 (1997), 5309, pp. 122-126
- [6] Li, X. X., He, J. H., Along the Evolution Process, Kleiber's 3/4 Law Makes Way for Rubner's Surface Law: A Fractal Approach. *Fractals*, 27 (2019), 1, ID 1950015
- [7] Li, L. J., Thermal Therapy for Eye Diseases, *Thermal Science*, 24 (2020), 4, pp. 2319-2324