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Ascaridia galli (Chicken Nematode) as a Source for Nanoparticle and Nanofiber

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Abstract: Recently, green synthesis or synthesis of nanoparticles and nanofibers has gained relevance. Ideally, nanoparticles and nanofibers are made from metallic sources. However, serious side effects have recently been reported following the use of metallic nanoparticles in biology and medicine. Under such circumstances, it becomes even more important to explore and identify more natural, environmentally friendly and effective metal substitutes. In some cases, nanoparticles and nanofibers, as well as many other nano components, are synthesized from more natural sources, such as bacteria, different species of algae, and fungi. However, few attempts have been made to synthesize nanoparticles from unusual sources such as nematodes, intestinal parasites in animals and humans. In this study, the first attempt was made to synthesize nanoparticles and nanofibers from the chicken roundworm *Ascaridia galli*. Parasites were extracted and isolated from chicken intestines, which were then processed to synthesize nanoparticles and nanofibers. Obviously, nanoparticles synthesized from natural sources are more attractive because they are environmentally friendly and cheap. Parasites, approximately 30-80 mm long, were carefully removed from chicken intestines and processed to synthesize nanoparticles and nanofibers. Nanoparticles were synthesized by acid hydrolysis and nanofibers were prepared by electrospinning technique. The synthesized nanofibers are hydrophilic in nature. Scanning Electron Microscope (SEM) images of the nanoparticles showed diameters of 48.46 nm to 20 µm, with nanofibers ranging in diameter from 88 nm to 2 µm, corresponding to the average standard size of nanoparticles and nanofibers. Intestinal parasites are widely used in biology and medicine due to their ability to evade host immunity and easily fuse with host tissues without causing antagonism. Since these nanoparticles and nanofibers are synthesized with parasites (living source) and degrade easily after use, they canbe considered as suitable substitutes for metallic nanomaterials.

Keywords: Nanoparticle, Nanofiber, Chicken nematode, Acid hydrolysis, Electrospinning, Scanning Electron Microscopy, *Ascaridia galli*

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Introduction

In recent years, nanotechnology has touched almost every aspect of life. Its importance continues to grow in the fields of medicine and regenerative biology. Nanoparticles, nanomembranes, nanofibers and nanorods have applications in almost all areas of life in the fields

of industry, biology, pharmacology and biomedicine (Wang and Wang, 2014). The unique versatility of nanoparticles is due to their size and dimensions (100 nm) and, interestingly, when materials are scaled down to the nanometer scale, they exhibit certain unique physical properties, whereas heavier materials exhibit constant physical properties (Abdel Goadet *et al*., 2020). One of the main reasons for the development of nanotechnology stems from the understanding of biological processes as they generally occur at the nanoscale (Kipp, 2004), with living cells typically being 10 microns in size and their building blocks being much smaller. Metals and heavy metals are frequently used to synthesize nanoparticles, which are commonly used in many biological and medical applications. Although used in biological and medical applications, they would have deleterious effects on humans (Agarwal *et al.,* 2013). In order to minimize or completely eliminate the risk of side effects, efforts are constantly made to explore and identify different materials that are both environmentally friendly and cost effective.

In this regard, many plant nanoparticles have been synthesized and this method of developing plant nanoparticles is considered as a green chemistry approach (Parveen *et al*., 2016). Apart from plant materials used as nanoparticles, there is evidence that microorganisms such as bacteria, fungi, and yeasts also synthesize nanoproducts (Li *et al.,* 2011). Cellulose and bacterial cellulose (BC) seem to be used for the synthesis of environmentally friendly nano-products, which seem to gain popularity recently (Jose *et al.,* 2020; Ma *et al.,* 2020). Therefore, it appears from these studies that nanoparticles synthesized from natural resources are more attractive due to their biocompatibility and lower price. Therefore in this study an attempt has been made to develop nanoparticles and nanofibers from cheaper sources or, to be precise, from waste, i.e. Intestinal parasites, such as the chicken nematodes, *Ascaridi agalli.*

Materials and Methods

Intestines from chickens were collected from slaughter houses. No animal was harmed in the experimentation protocol. Parasite-infected intestines were carefully washed and then dissected for parasitic infection, identified as *Ascaridia galli*, and carefully collected into petri dishes. These *Ascaridia galli* worms are creamish white and about 70 to 80 mm long. Collected worms were dried overnight in a 37°C incubator. After the worms were thoroughly dried, they were ground into a fine powder with a motor and pestle and then processed to synthesize nano-particles and nanofibers. Scanning electron microscope (SEM) images were taken to determine the size of the nanofibers and nanoparticles.

Preparation of nanoparticles:

Nanoparticles were produced from purified *Ascaridia galli* powder by repeated acid hydrolysis. Nematode powder was soaked in 3M HCl for acid hydrolysis and incubated in a constant temperature water bath at 90°C for 90 min. The samples were centrifuged at 6000 rpm for 10 min and the pellet was collected. The acid hydrolysis step was repeated three times and the final pellet was suspended in distilled water to dilute the acid concentration. The suspension was dialyzed against distilled water.

Preparation of the nanofibers:

2% of Nematode powder was dissolved in 80% (w/v) acetic acid. 1 ml of 10% Polyvinyl Alcohol (PVA) Polymer was added as an additive to the mixture to achieve a coarse fiber consistency. The mixture was electrospun using an electrospinning device at a potential of 18 kv with a tip-plate distance of 15 cm and a flow rate of 0.5 ml/h.

Results and Discussion

Nanoparticles and nanofibers were successfully synthesized using chicken nematodes, Chicken roundworms collected from chicken intestines (Figs. 1, 2). A scanning electron microscope (SEM) image of the nanoparticles (Fig. 3) show a

Fig. 1: Collection of worm from intestine.

Fig. 2: Nematode worms.

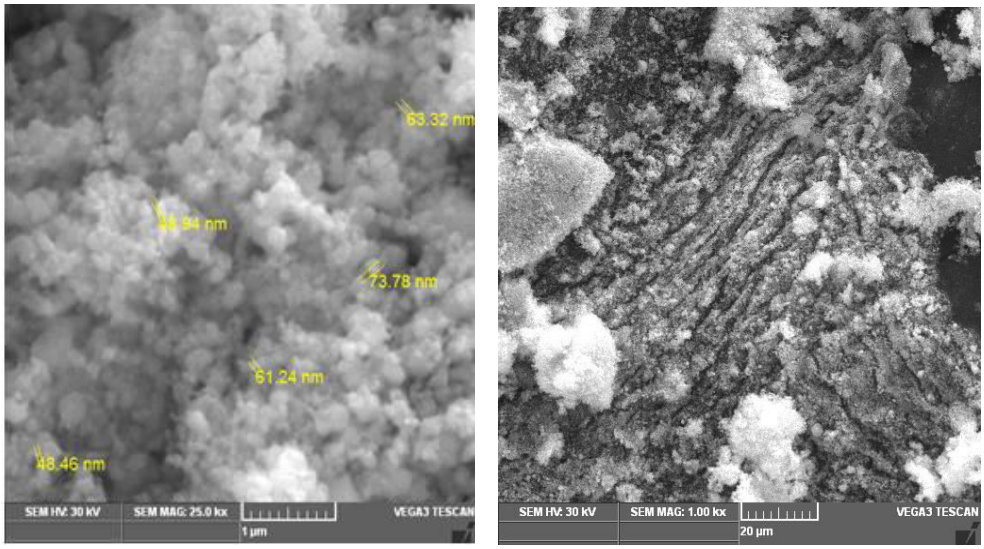

Fig. 3: Nano particle.

diameter of 48.46 nm – 20 µm. The nanofibers (Fig. 4) have diameters between 88 nm- 2 µm. These measurements are consistent with the average standard size of nanoparticles and nanofibers commonly used in scientific and other biological applications.

In this study, hydrophilic nanoparticles and nanofibers were successfully synthesized by using a rather unusual source, chicken roundworm, chicken nematode. As mentioned earlier, metal ions and other non-metal ions can be effectively incorporated into various nanostructures, but cannot be used for medical and biological applications due to their side effects.

Nanoparticles are frequently used in cancer treatment due to their ability to be delivered directly to desired cells (Verreck *et al*., 2003; Hammel *et al*., 2004) and can also precisely target tumor cells in healthy cells .Besides nanoparticles, nanofibers are also used in tissue engineering, bone remodeling and skin regeneration. Several methods are available for nanofiber synthesis, but nanofiber synthesis using electrospinning technology yields high-purity nanofibers, which can also be effectively used for biologically active cell encapsulation and packaging of enzymes for efficient delivery in biological systems (Maria Leena *et al*., 2021), so

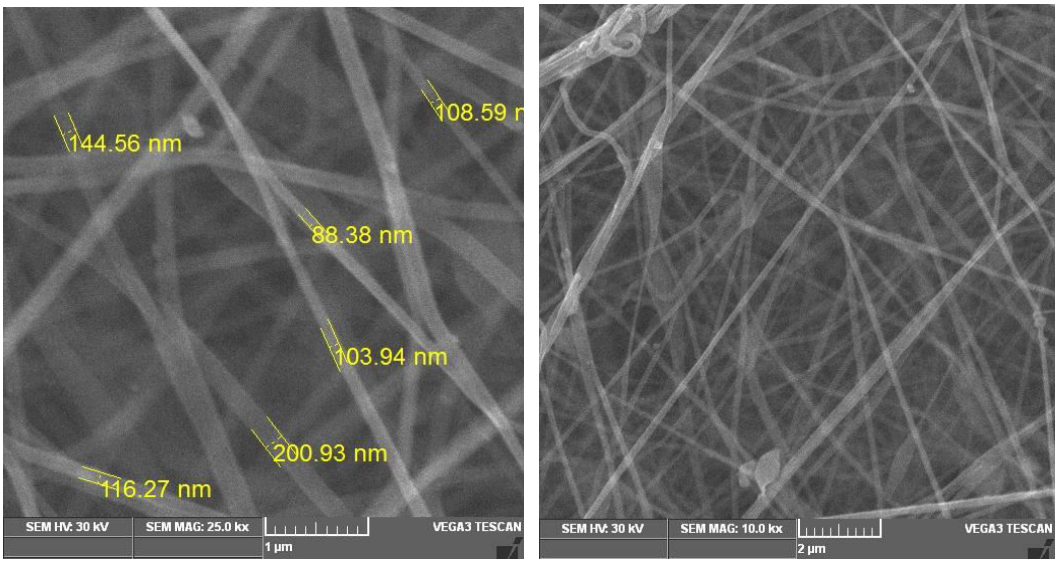

Fig. 4: Nano Fiber.

the same technique was used in this study. Apart from these applications, nanofibers are also used in wound healing and treatment due to their light weight, nanoscale porosity and nanometer diameter (Wróblewska-Krepsztul *et al.*, 2019). In a recent study conducted by Lihua Lou *et al.* (2020), applications of nanofibers seem to show promising results in energy storage protective clothing and air/gas filtration.

In conclusion, it can be said that nano-tructures derived from natural ingredients can often be used in biological and medical applications because they are more environmentally friendly, more economical and, most importantly, biocompatible. Therefore, in this study, nanoparticles and nanofibers were obtained from a very natural or unusual source (a parasitic worm).

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