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Designing a New Anti Microbe and Virus Volleyball Ball

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ABSTRACT

Ball sports are used for various purposes among athletes. Volleyball is one of the most popular sports which very limited during the outbreak of Corona virus. Therefore, the purpose of this study was to design a new anti microb and virus Volleyball ball**.** The present study was done in order to design and manufacture new Volleyball ball to prevent microbes and virus distribution among Volleyball athletes**.** Initially, in order to design and produce a new antimicrobial Volleyball ball to prevent germs and viruses among Volleyball athletes, using rubber, it was combined with the material of sports balls such as titanium oxide, paraffin, and etc in the Nider machine. The obtained rubber material was transferred to the rubber baking machine for making the first layer of the ball. Then, in order to maintain the spherical shape of the first layer of the new Volleyball ball, we covered it with thread. To form the third layer of the new ball and to increase its bounce, a special fabric was used instead of rubber. Finally, we used special leather foam to form the last layer of the new ball. In the latex machine, we covered it twice with glue in order to better adhesion of the foam to the third layer. For the first time in the ball industry, this study investigated the antimicrobial ability of nano-silver against microorganisms. Based on previous research that examined the antimicrobial properties of nano-silver against microbes in various industries , it can be suggested that the use of nano-silver in the ball industry could be useful in eradicating a variety of microbes and viruses.

Keywords: New Ball, Corona Virus, Volleyball, Nanosilver

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INTRODUCTION

Ball sports are used for various purposes among athletes. Volleyball is one of the most popular sports which very limited during the outbreak of Corona virus [1]. One of the main problems of sports venues, especially with the onset of the corona virus, is the threat of the health of the athlete community. One of the main causes of infectious diseases is the presence of dangerous microorganisms. Infectious diseases enter the human body in different ways. One of the main ways of transmitting this disease to the body of athletes is through the contact of Volleyball balls with the contaminated surface of the ground and the hands of Volleyball athletes [2].

According to these cases, it can be stated that contaminated sports equipment in sports centers is one of the main places for the existence and growth of microbes and bacteria [3], which causes a variety of diseases for all athletes, especially those athletes who have a congenital or acquired immune system defect. On the other hand, in addition to athletes, people in the community, especially children and adolescents, are twice as likely to contract infectious diseases for playing local and recreational Volleyball games [4].

Nanoparticles have new and improved properties against larger nanoparticles due to their particle size and distribution. Research in this area shows that silver nanoparticles are superior to other metals in many fields [5].

The main characteristics of silver nanoparticles are: insensitivity, high stability, environmental compatibility, heat resistance, increased resistance and compatibility against microorganisms. They also have the ability to add to fibers, polymers, ceramics, stones and dyes without losing the properties of their materials [6]. The antimicrobial properties of silver nanoparticles have led to the expansion of its applications in the textile, paint, ceramic, pharmaceutical, agricultural, food packaging and cosmetics industries [7].

Cook et al. prepared silver nanoparticles by microwave method and investigated the antibacterial properties of nanoparticles at five different concentrations. The results showed that the antibacterial properties of these nanoparticles against gram-positive bacteria are higher than gram-negative [8].

Studies have shown that polymer nanocomposites containing silver nanoparticles have long-lasting antibacterial resistance and, however, are not toxic to human cells and tissues. Also, these nanocomposites are a good choice for killing all kinds of bacteria and fungi [9].

According to a study by Ramezani et al., low concentrations of silver nanoparticles are suitable for eradication of carp viral virus. Therefore, it can be considered as a suitable antiviral agent in inhibiting SVCV infection in aquatic animals [10].

Volleyball sport requires constant contact of sports balls with the contaminated surface of the ground and the hands of athletes, the use of sports balls can lead to the transmission of germs and viruses to the body of athletes. COVID-19 transmission rate is almost higher than SARS, which has forced sports organizations to implement restrictions since its inception and caused most sporting events to be suspended or postponed [11]. The sports world is badly affected by the COVID-19 crisis that it has never been seen before. All physical activity and group sports were restricted in many countries with the pandamic of the Coronavirus [12]. The sports world is currently going through a difficult phase, because the COVID-19 crisis is one of the most important issues facing the international sports sector in recent years [13]. Therefore, the purpose of this study was to design a new anti microb and virus Volleyball ball**.**

METHODOLOGY

Designing a new Volleyball ball

Initially, in order to design and produce a new antimicrobial Volleyball ball to prevent germs and viruses among Volleyball athletes, using rubber, it was combined with the material of sports balls such as titanium oxide, paraffin, and etc in the Nider machine. The obtained rubber material was transferred to the rubber baking machine for making the first layer of the ball. In order to maintain the spherical shape of the first layer of the new Volleyball ball on it, we covered it with thread. To form the third layer of the new ball and to increase its bounce, a special fabric was used instead of rubber. Finally, we used special leather foam to form the last layer of the new Volleyball ball and to better adhesion of the foam on the third layer in the latex machine, we covered it twice with glue.

Inclusion criteria

In this study, the inclusion criteria were: sample of Volleyball balls size V5 (official size of Volleyball ball for matches) with weight (265 to 270 grams) and with air pressure 4psi, environment (66 ± 1 cm), bounce from a height of 1 meter (66 60 60 cm) and resistance to 2000 impact tests at a speed of 50 km per hour inside the

impact testing device. Finally, the sample of the new antimicrobial Volleyball ball designed was compared with the sample of a regular Volleyball ball [14].

Method of data collection

In order to measure the resistance of the samples to strong and hard blows, an impact test device made in China was used. The method of measurement was that the samples of Volleyball balls designed before entering the microbiology test for comparison with the samples of normal Volleyball balls were placed inside the impact testing device. They had to withstand against 2,000 hard blows at 50 km / h inside the impact test machine without any deformation [15].

After the impact test was finished, all the samples inside the device were kept on shelves for 24 hours to make sure they had not been punctured.

Undamaged sample balls were measured using an advanced caliper after 24 hours [16]. The measurement method was that various points of ball taken out of the impact tester were measured in 12 efforts as Figure 1 indicates.

Figure 1. The caliper used to measure the diameter of sample balls

Sample balls with nonstandard diameters according to FIVB standards (66±1cm) and that onese were deformed due to the test conducted in impact tested were excluded from the study.

Then, in order to antimicrobize the new Volleyball ball, we used a nano-silver solution of 1 liter 1000 ppm made by Nano Sadra Company. The nano-silver solution was combined in a ratio of 3: 1 in distilled water, and for better adhesion and lifelong nano-silver on the outer surface of the new Volleyball ball, some pva adhesive was mixed with the solution. The solution was then sprayed on all parts of the new designed Volleyball ball. Then, according to the experts of Nano Sadra Company, in order for the nano-silver particles to remain on the sample forever, they were kept for 24 hours without any use.

RESULTS

This research is based on many studies conducted around the world that have shown the antimicrobial properties of nano-silver in various industries [17-20].

Initially, in order to antimicrobial the new Volleyball ball to control and prevent germs and viruses, a new designed Volleyball ball was prepared along with several other samples of Volleyball balls, then 800 cc solution of silver nanoparticles with 100 cc of PVA adhesive and 300 cc of distilled water were combined, and then sprayed and immersed on all parts of the outer layer of the Volleyball ball. In order to evaluate the performance of this coating on the desired sports ball, bacterial susceptibility was measured by disk diffusion method at three concentrations of 50, 100 and 150 ppm nano-colloids of silver particles. At concentrations above 200 ppm, this substance is easily converted to ions in the presence of air and can be absorbed into the body by contact, which can be very dangerous and toxic. According to international standards of acceptable

concentrations in it the cfu test was used to measure the antibacterial test and the results showed the resistance of nanosilver to bacteria according to the Figure 2.

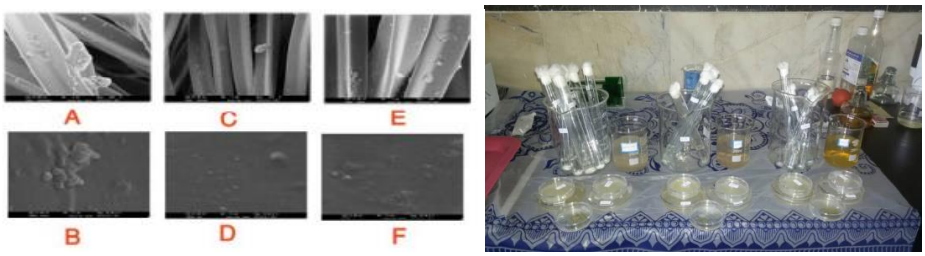

Figure 2. Microbial and virus identification test and nano-silver resistance to repeated washing at different ppm

DISCUSSION

The aim of this study was to design a new antimicrobial Volleyball ball using nano-silver to control and prevent viruses and microbes, especially the infamous Corona virus among Volleyball athletes. For the first time in the ball industry, this study investigated the antimicrobial ability of nano-silver against a variety of microorganisms. Based on the previous researches, it was observed that the use of nano-silver in the ball industry in order to eliminate all kinds of microbes and viruses can be useful.

The findings of this study showed the resistance of nanosilver to a variety of microbes on the new designed volleyball. In consistant with our results, Mirza Baba et al., (2011) investigated the antimicrobial effect of nano-silver hall floors. The results of their research showed that the samples of indoor flooring that were coated with 25 ppm nano-silver solution lead to percentage of bacterial reduction to 73.3%. However, in the sample of floors that were sprayed with nano-silver with 50 and more ppm, the percentage of bacterial reduction reached 99.99%. In addition, the strength of silver nanoparticles on the samples was investigated after 1 to 10 washes. The silver particles on the floor surface retained their resistance to repeated washing and retained [21]. Also, zic et al., (2017) examined metal nanoparticles and carbon nanotubes-complete antimicrobial fillers in polymer-based food packaging materials. Their research findings showed that the use of nanoparticles to antimicrobial food in the packaging industry can be very useful [22].

The results of this study are in line with the findings of Khajavi et al., (2011). They investigated the antibacterial and anti-wrinkle properties of cotton fabric using polycarboxylic acids, chitosan and nanosilver. The results of their research showed that the simultaneous use of polycarboxylic acid and silver nanoparticles that were sprayed on these materials causes their antibacterial properties. On the other hand, by increasing the cooking temperature for each of these ingredients alone and together, it improves the anti-wrinkle and antibacterial effect [23]. Mohammadi et al., (2011) showed that nano-silver, which has a small diameter and size, due to its large surface area, increased its antimicrobial properties compared to larger silver particles [24].

The use of nano-silver in the ball industry can be effective in controlling and preventing coronavirus. In this regard, Glig Wade et al., reported the antimicrobial activity of nano-silver against the activity of various coated viruses [25]. Sandy et al., conducted a study examining the antimicrobial and effective properties of silver nano in the health and pharmaceutical industry. To date, many researchers have investigated the antimicrobial efficacy of nano-silver against pathogenic microorganisms [26]. Lim Pan et al., in a study examined the use of titanium in the manufacture and design of sports equipment. The results showed that the use of pure titanium in the material of tennis rackets improves the inertial force of the blows transmitted to the ball through the tennis racket [27]. Pinggo et al., (2009) investigated photocatalytic inactivation of bacteria through palladium oxide and titanium oxide composites. The results of their study showed that the presence of visible light in palladium and titanium oxide composites causes severe damage to the bacterial cell wall and cell membrane [28]. Georges et al., (2011) investigated the antimicrobial properties of nano-silver. The results of their research showed that nano-silver is a non-toxic substance and can be used as an antimicrobial agent in the engineering industry [29].

However, further longitudinal and experimental studies were needed to better established the positive and negative effects of new anti microb and virus Volleyball ball.

This study has several limitations that need to be discussed. We only used nano-silver antimicrobials in Volleyball ball. Because the structure of sports balls is different, it should be examined in the future whether the use of nano-silver can be used in other sports balls.

CONCLUSION

The use of nano-silver against germs and viruses has long been considered by humans in various industries [30-33]. Therefore, for the first time in the ball industry, this study investigated the antimicrobial ability of nano-silver against various microorganisms and can be stated based on several studies. The use of nano-silver in the ball industry can be used to kill a variety of microbes and viruses. However, further longitudinal and experimental studies were needed to better established the positive and negative effects of new anti microb and virus volleyball ball.

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چکیده فارسی

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چکیده

مقدمه: پرداختن به ورزش‌های توپی در بین ورزشکاران و عموم افراد جامعه به مقاصد مختلفی صورت می‌گیرد. یکی از این ورزش‌های پر طرافدار ورزش والیبال نیز می باشد که از زمان شیوع ویروس کرونا همانند سایر رشته‌های ورزشی به شدت محدودیت‌های برای ورزشکاران این رشته ورزشی ایجاد نموده است.لذا هدف از پژوهش حاضر طراحی و ساخت توپ جدید والیبال آنتی‌میکروب با استفاده از نانو نقره جهت کنترل و پیشگیری از کروتا ویروس در بین ورزشکاران والیبالیست نیز می باشد.

روش‌شناسی: پژوهش حاضر از نوع کاربردی و آزمایشگاهی می‌باشد که به منظور طراحی و ساخت توپ جدید والیبال آنتی میکروب جهت کنترل و پیشگیری از میکروب‌ها و ویروس‌ها در بین ورزشکاران والیبالیست می‌باشد .

نتیجه‌گیری: این پژوهش برای اولین بار در صنعت توپ‌سازی به بررسی قابلیت ضد میکروبی نانو نقره علیه انواع میکروارگانیسم ها پرداخت و با استناد به پژوهش‌های متعدد انجام شده که به بررسی خاصیت آنتی میکروبی نانو نقره علیه میکرو ارگانیسم ها در صنایع مختلف پرداخته بودند. می‌توان بیان کرد استفاده از نانو نقره در صنعت توپ‌سازی می‌تواند در جهت از بین بردن انواع میکروب ها و ویروس‌ها مفید واقع گردد.

کلید واژه‌ها: توپ جدید، کرونا ویروس، والیبال، نانونقره