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The combined effect of *Weisella cibaria* and *Fusarium oxysporum* nanoparticles on cervical cancer cells

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Abstract

The predicted global cancer burden is expected to surpass 20 million new cancer cases by 2025. Despite recent advancements in tumor therapy, successful cancer treatment remains challenging. The emerging field of nanotechnology offers great opportunities for diagnosis, imaging, as well as treatment of cancer**.** The biosynthesis of silver nanoparticles by fungi is an ecologically clean and nontoxic method compared to other physical and chemical methods. The purpose of this study is to determine the Synergistic Effect of Combination Nanoparticles Synthesized from *Fusarium oxysporum* with *Weisella cibaria* against cervical cancer cells. The study has done from 2022 to March 2023 in the food microbiology laboratory in the Department of Biology / College of Science / Mustansiriyah University. Lactic acid bacteria (LAB) were isolated from food sources (Turnip, Cabbage, Cauliflower), after serial steps from treated NaCl , then cultured in MRS (Man-Rogosa-Sharpe) broth, finally examined under a microscope. The antibacterial activity of Cell Free Supernatant (CFS) s that was produced by these isolates was detected to choose the best one and diagnosed by PCR and DNA sequencing. The nanoparticles ($AgNo_3$) that were produced from *Fusarium oxysporum* by biosynthesis were obtained from higher studies laboratory for fungi, and these fungi was submitted to toxicity test. The Synergist effect of chosen LAB and *Fusarium oxysporum* nanoparticles was studied against cervical cancer cells. Results show that all food sources were rich in LAB and the best antibacterial activity was to turnip source and according to molecular diagnosis was *Weisella cibaria* , that recorded in NCBI as (MG7865551). The synergistic effect of *W. cibaria* and nanoparticles showed and decrease the cancer line viability rate after 72 hr. exposure to this effect.

Keywords: Cervical cancer, *Fusarium oxysporum,* Lactic acid bacteria, Nanoparticles, *Weissella cibaria*.

Introduction

Cervical cancer is the most common malignancy among females in low- and middle-income countries (LMICs) and is associated with high mortality rates and represents a considerable burden for public health systems[1].

Nanoparticles are very small particles with sizes ranging from 1 to 100 mm. Silver nanoparticles are currently used extensively in the medical, healthcare, and environmental fields. The antimicrobial activity of silver nanoparticles in medicine is the capacity to

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eliminate a variety of infections and multidrug resistance, and widely applied as antitumor effects on cancer cell lines including cervical cancer[2,3].

Fungi have the potential to form "ecologically clean" metallic nanoparticles and are better nano-factories than plants and bacteria comparatively easy for large-scale nanoparticle synthesis as they produce large amounts of enzymes which assist the process. Many fungal species have for the intra- or extracellular synthesis of nanoparticles as *Fusarium oxysporum*[4,5].

Fusarium oxysporum is Endophytic fungi that can be found inhabiting the living internal tissues of some plants. it has anticancer effects which has cytotoxicity against cancer cell line[6].

Weissella cibaria Gram-positive rods that belong to a lactic acid bacterium (LAB), non-spore-forming, non-motile, heterofermentative, and negative for catalase[7].The distribution of this species is extensive in traditional fermented foods such as pickles [8], or in some types of cheese [9]. Similar to other LAB species, *Weissella* spp. play important roles in activity against numerous pathogenic bacteria or other microorganisms [10], which are used as probiotics as an alternative to chemical drugs like antibiotics [11].

Today, the natural environment becomes an interesting source of new therapeutic drugs especially anticancer. The efficacy of probiotics and *Fusarium oxysporum* nanoparticles against pathogenic microorganisms and anticancer are available, There are did not found any study about the synergistic effect between the Lactic Acid Bacteria *Weissella cibaria* and *Fusarium oxysporum* nanoparticles against cancer, especially cervical cancer, and because multi-drug resistance (MDR) occurrence, the purpose of this study is to find a natural treatment with positive side effect as an alternative drug to chemicals used that have a negative side effect in addition to their high cost to the patient.

Materials and Methods

Preparation of cell free supernatant extract from (Turnip, Cabbage, Beet and Cauliflower)

Four types of food were collected and brought to the laboratory: Turnip, Cabbage, Beet and Cauliflower were cleaned with distal water. This work was done in the food microbiology laboratory in the Department of Biology / College of Science / Mustansiriyah University.

Two grams of each food specimen were taken by cutting in a sterile condition, then 18ml of NaCl 0.1 % was added, with well moving, Serial dilutions were prepared and cultured in MRS (Man-Rogosa-Sharpe) broth for activation of the bacteria, then incubated in anaerobic condition for 24 hrs./ 37ºC , then cultured on MRS agar and also incubated in the same anaerobic conditions, finally examined under a microscope [12].

A slide of each colony was prepared and stained, finally examined under a microscope; the morphology was compared with Lactic Acid Bacteria spp[13].

Each isolate of LAB was inoculated in 10ml of MRS broth for 24 hrs.at 37ºC. centrifugation of the culture at 8000 xg for 5 min was done to remove bacterial cells, then filtered by using 0.22µM filter paper and stored at 4ºC,the product is called Cell-Free Filtrate or Supernatant (CFS) [14].

Bacterial strains and Antimicrobial activity

Microbial strains including *E.coli*, *Pseudomonas*, *Klebsiella* and *Staphylococcus* accessed from a higher study laboratory at Mustansiriyah University, College of Science. The LAB-mediated antimicrobial activity was assessed with the deferred antagonism method as described by Jasim *et. al.*[15] with minor modifications. An overnight culture of each LAB strain was spotted on MRS agar and incubated for 24 h at 37 ºC. Next, the MRS agar was overlaid with 10 mL of soft TSA containing the indicator pathogen (5 9 107 CFU/mL). The plate was incubated for another 24 h at 37 ºC. The radius of the developed clear zone was measured.

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Synthesis of Silver Nanoparticles (synergistic effect)

Mixing 250 ml of deionized water with 2.00 g of silver nitrate and heat by hot plate and magmatic vortex to 40ºC. Following that, 10 ml of the leaf extract was added into the silver ion solution drop by drop. The mixture's color was subsequently adjusted to yellow. After 4 hours of stirring at room temperature, the mixture's color changed to a deep red or brown indicating the creation of colloidal silver nanoparticles. The obtained colloid samples were kept in a dark bottle, the solution's color was varied for five days, and AgNPs that were produced from the mixing reactions and the active reduction of Ag+ both showed a brown or deep red color. The solution's color allowed examination of the absorbance by UV-Vis to confirm AgNps production. Biosynthesized nanoparticles from *Fusarium oxysporum.* The nanoparticles ($AgNo_3$) that were produced from *Fusarium oxysporum* by biosynthesis were obtained from higher studies laboratory for fungi / Dr. Hamzia Ali Ajja, and these fungi were submitted to toxicity test according to [16]. The nanomaterial was 70 nanometers in size, spherical in shape and prepared in the fungi laboratory / Department of Biology / College of Science / Mustansiriyah University.

A Crystal Violet cell viability assay was performed on 96 well plates to assess the cell-killing effect of the selected LAB isolate (Santa Cruze Biotechnology, USA). After 24 hours or when a confluent monolayer is formed, human cervical cancer cells were seeded at 7000-10 000 cells per well. Within the culture medium, cells were treated with (CSF and nanoparticles) in dilutions ranging from 1 g to 0.312 g.

The viability of the cells was determined 72 hrs. after exposure by extracting the medium, applying 50l of Crystal Violet stain (Sigma Alderch.co), and incubating for 2 hrs. at 37ºC. The stain was cleaned, and the area was then washed with PBS. The experiment was replicated using a microplate reader (Biochrom, UK) to calculate absorbance at 492 nm (test wavelength). The experiment was replicated three times using a microplate reader (Biochrom, UK) to measure absorbance at 492 nm.

For the cancer cells, the endpoint was determined using the proliferation rate =(B/A) 100. The mean optical density of untreated wells is A, and the optical density of treated wells is B. The IC50 value represents the concentration at which half of the cells are killed. This work was done at the Cancer Research Center, Al-Yarmuk, Baghdad.

The cytotoxic effect of different concentrations of CSF and nanoparticles on the proliferation of HT-29 cells in a 96 plates was carried out using (AMG) method as follows:

1. The required concentrations were prepared for the CSF and nanoparticle (0.312 ,0.625 , 0.125 ,2.5 ,5 and 10) µg/ ml.

2. Cell suspension for the cell line was prepared by shaking off the old culture medium and 3 ml of Trypsin/ EDTA solution in the flask.

3. 200 µl of cellular suspension was placed in each well, and incubated at 37ºC with 5% Co_2 for 24 hrs.

4. 200 µl of CSF and nanoparticles concentration were added to each well.

5. After the incubation, the CSF and nanoparticles were removed and washed with PBS and dyed with MTT dye solution and incubated at 37ºC for 2.5 hrs.

6. The dye is carefully removed and 130µl of BMSO is added to each well, the viability can be concluded as:Viability rate (after taking the test)% = 100 – inhibition or cytotoxicity rate

Polymerase Chain Reaction (PCR)

Chromosomal DNA was extracted according to the manufacture instructions of G-spin ™ Total DNA Extraction Kit (Intron Biotechnology,Korea).

Chromosomal DNA was analyzed by agarose gel electrophoresis in 5 V, 1.5 hr. and 1 % agarose. Agarose was prepared at concentration 1 % by dissolving in 100 ml of 1 x TBE buffer, the mixture was placed in boiling water bath until it become clean, and the agarose was left to cool at 60 ºC, and then was put in to the taped gel tray. Near the edge of the gel from one side, a comb was put. When the gel was hardened by becoming opaque, remove the comb and the tape carefully. TBE (1x) buffer was poured into gel tank and horizontally the tray was put

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in the tank of electrophoresis. The wells were filled with the mixture of the chromosomal DNA. Five µl of DNA ladder 1000 bp were loaded in one lane, which acts as a marker in the electrophoresis process. After electrophoresis, the gel is subjected to UV using trans illuminator and photographed with a digital camera. The amplification was performed in biorad (T-100) thermal cycler, Five µl of the DNA were mixed with universal primer, 1.5 µl from each primer and 4.5µl of nuclease free water to reach 25 µl as a final volume. This process has been done as same in B- except the conditions of experiment here, were 7 V/cm, 1.5-2 hr. and 1.5 % was the concentration of agarose to analysis the amplified PCR products. The specimens were sent to Jordan/ Amman to complete this process according to (Mycrogen Company,Korea) instructions.

Nucleotides and protein of isolate were analyzed by software of NCBI (National Central Bank Isolate) and sequencing of amino acids was known according to sequencing of nitrogen bases.

Results and Discussion

In the present study, vegetable samples (Beet, Cauliflower, Turnip and Cabbage) were observed for Lactic Acid Bacteria presence. Results were accompanied with study Bjorkroth *et. al.*[10], that LAB is the main species isolated from fresh vegetables and they are also responsible for silage fermentation, this study appears that since 2002 LAB were discovered in vegetables, also mentioned that LAB can be isolated from various sources like goat milk, better, dairy and vegetable [17].The microscopic examination appears the presence of a small coccobacilli or rods in chains and pairs as described in Table1 and Fig. 1.

Table 1. Properties of LAB isolates

No.	Source(LAB)	Culture Properties	Microscopic Properties
1	**Turnip**	**White colonies spaced**	**Bacilli**
2	**Cabbage**	**Straight white colonies**	**Coccobacilli in chains and some in pairs**
3	**Beet**	**Yellow colonies**	**Bacilli**
4	**Cauliflower**	**Big white colonies**	**Like blocks**

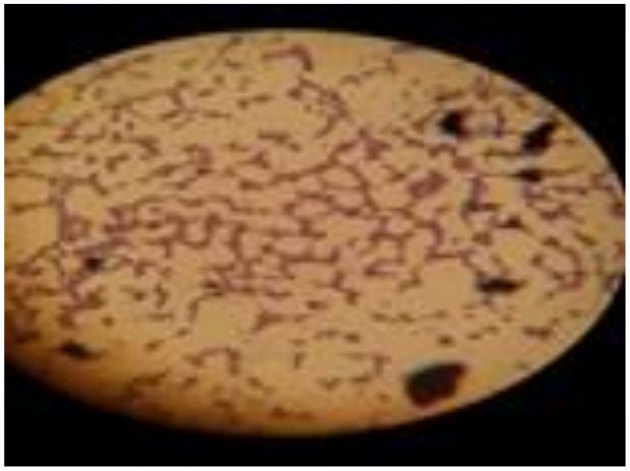

Figure 1. Microscopic examinations of LAB isolate, Coccobacilli rod shape

In the present the study showed that results appeared the first isolate that was isolated from Turnip had higher activity than others, the inhibition zone was 30 mm against *S. aureus* and 28 mm against *E.coli*, but it could not inhibit *Klebsiella*, whereas less inhibition showed in *Pseudomonas* 10 mm.

The three isolates did not inhibit the pathogenic bacteria generally, except isolate No.2 which inhibits *E. coli* with 10 mm only, but the rest of the isolates did not give any result as shown in Table 2 and Fig. 2, So we diagnosed the first isolate molecularly to use it in other analysis and experiments, and called T1, according to Turnip (T) and first isolate 1, and the remaining three isolates were neglected.

Table 2. LAB isolates have antibacterial activity against pathogenic bacteria.

No. of Isolate	Inhibition zones of Bacteria in mm		
	S. aureus	***E. coli***	***Klebsiella Pseudomonas***
1	**30**	**28**	**10** -
2	-	**10**	- -
3	-	-	- -
4	-	-	- -

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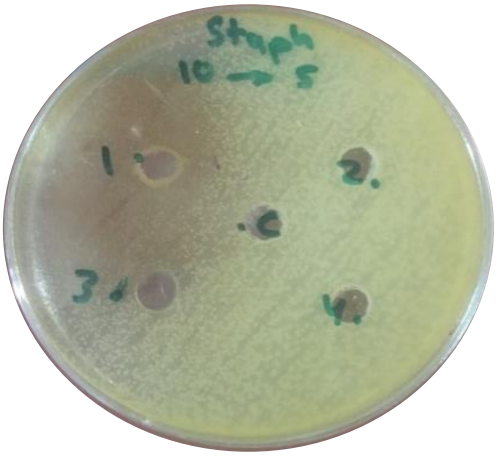

Figure 2. Antibacterial Activity of LAB isolates against *S. aureus*

In the current study, the result of molecular diagnosis was the appearance of a band in electrophoresis for genome, and product by PCR as shown in Fig. 3, this is refer to the presence of the result of PCR .

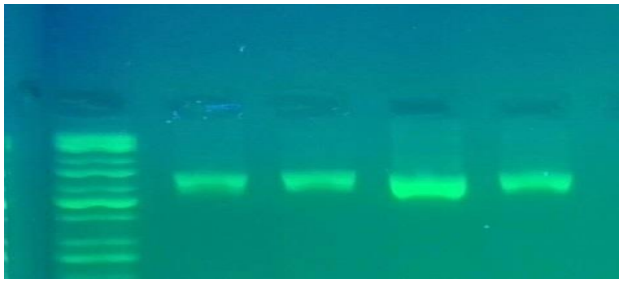

Figure 3. The PCR product of LAB isolate

After sequencing and the nucleotide and protein analysis, T 1 isolate was diagnosed as *Weisella cibaria* and recorded in NCBI as (MG 7865551), the isolate identifies was 668/677 (99%), whereas Gaps were was 0/677 (0%), all the nucleotide and protein analysis results are as following:

In the results of synergistic effect of *Weiseella cibaria* and biosynthesis nanoparticles of *Fusarium oxysporum*, we noticed increasing this activity in comparison with *W. cibaria* CFS alone as in Table 3 and Fig. 4.

Table 3. Synergistic antibacterial effect ot *Weisella cibaria* CFS and biosynthesis nanoparticles of *F. oxysporum* against pathogenic bacteria

Natural Agent	Inhibition zones of tested bacteria in mm			
	E. coli	***Pseudomonas***	***Staphylococcus***	***Klebsiella***
***W. cibaria* CFS**	**10**	**17**	**20**	**19**
***F.oxysporum* NPs**	**18**	**20**	**22**	**19**
CFS+ NPs	**30**	**22**	**25**	**26**

Staphylococcus ***E. coli*** ***Pseudomonas aeruginosa***

1:Control 2: Synergistic Effect of *Weissella cibaria* 3: *Fusarium oxysporum* 4: CF

Figure 4. Synergistic antibacterial effect of *Weisella cibaria* CFS and biosynthesized nanoparticles of *Fusarium oxysporum* against pathogenic bacteria

Through Table 3 we observed that synergistic effect of *W. cibaria* CFS and NPs of *Fusarium oxysporum* overcomes effect of CFS and NPs alone, this antibacterial activity recorded varied between 22-30 mm to (CFS+NPs), whereas ranged 10-19mm to CFS alone , but NPs alone was higher than CFS alone. The zones of inhibition ranged between 18-22mm. This variety of inhibition is due to ability of each CFS, NPs and their activities together.

Also our results pointed to the clear effect of synergistic activity on *W. cibaria* CFS and

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biosynthesized nanoparticles of *Fusarium oxysporum* and called (WF), As we show in Figs. 5, 6 and 7 minimize the cancer line when they were used WF in four concentrations.

After 72 hrs. of exposure, the rate of cervical cancer proliferation under the influence of the used concentrations was recorded in a reader device as shown in Table 4.

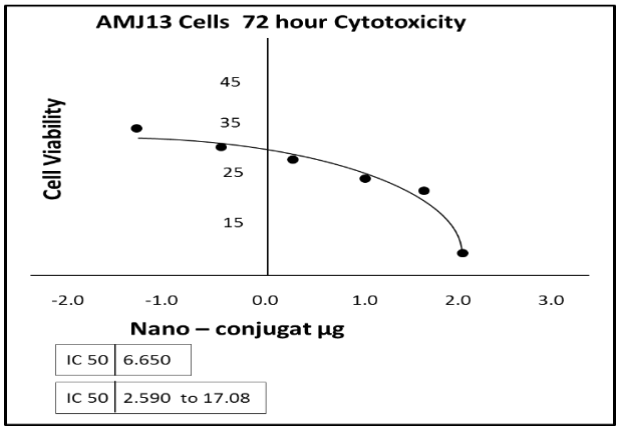

Figure 5. Cancer cells after 72 hrs. cytotoxicity.

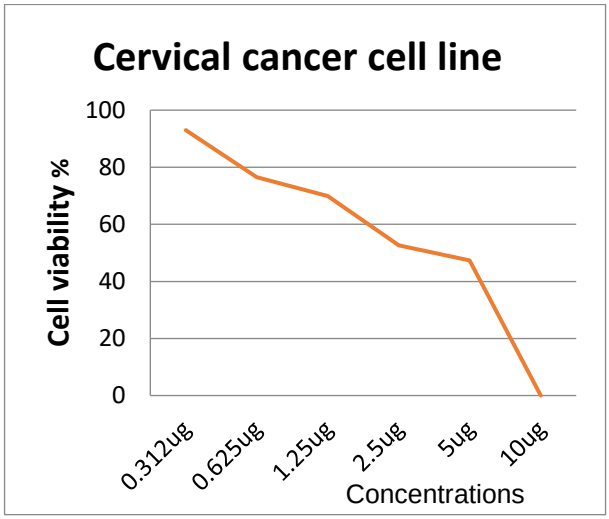

Figure 6. After 72 hours of exposure to the used concentrations, measured the rate of viability of cervical cancer cells

Table 4. The rate of viability of the cervical cancer cells as recorded by reader system

0.312 µg	0.625 µg	1.25 µg	2.5 µg	5 µg	10 µg	control
0.342	**0.221**	**0.4**	**0.179**	**0.116**	**0.0074**	**0.472**
0.415	**0.278**	**0.262**	**0.122**	**0.15**	**0.007**	**0.52**
0.387	**0.338**	**0.223**	**0.123**	**0.136**	**0.0059**	**0.51**
0.267	**0.248**	**0.203**	**0.159**	**0.134**	**0.0058**	**0.388**
0.326	**0.255**	**0.194**	**0.183**	**0.104**	**0.0059**	**0.515**

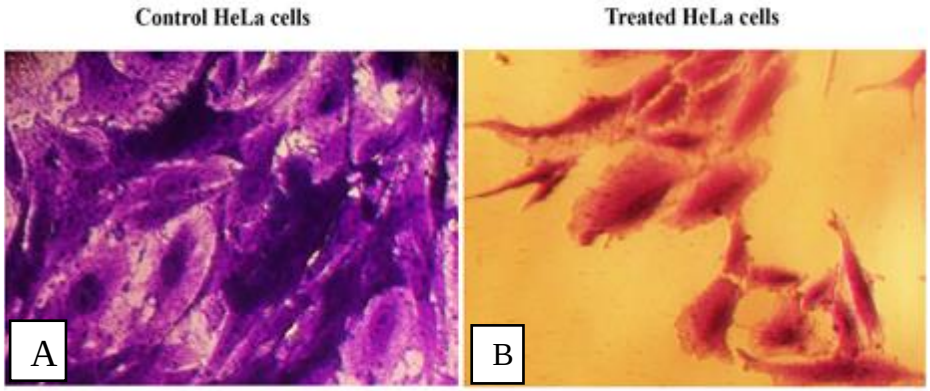

Figure 7. Cervical cells (A) control cells, no treatment (B) treated cell, 2nd high concentration

Discussion

The present study agrees with the study Kamboj *et. al.*[18] and Mohsin *et al.*[19] showed that *Weisella* always appears in culture as white colonies, small, smooth and shiny. The presence of several fractions (contained proteins with a molecular mass less than 500 Da) may be the cause of T1 inhibition of studied

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bacteria; in vitro findings related to the peptidic nature of the LAB species linked to bacteria inhibition[20,21,22], or may be occurrence the inhibition due to that some compounds work on the cell membrane and depolarize it, So, the cell wall synthesis inhibition, these compounds known as Diacetyl organic acids (lactic , formic, acetic and propionic) the pH of the medium was reduced as a result of this, So can compete for nutrients [20,23,24].

Previous studies pointed out the antibacterial activity of LAB sp. because of hydroxyl fatty acids and phenolic compounds , these antimicrobial agents were conducted to act as decrease the electrochemical proton gradient, and H_2O_2 by peroxidation of lipids membrane ,so, changing the permeability of the cell membrane, resulting in disruption of the substrate transport mechanism[21-23]. Because they are uncertain of the rate of activity and properties of its compounds, the behavior of LAB isolates CFS varies from one isolate to the next, depending on the strain's biochemical properties as well as the physical and chemical conditions of growth[24,25,26].

Weiseella cibaria was first documented by Bjorkroth *et. al.*[10] found in various sources, plays important roles in food fermentation, its activity render to have compounds and materials that are responsible for cell membrane adherence and make holes through which cellular material diffuses out. Later these compounds will affect on synthesis of the cell wall or the DNase and RNase activity[27].

The significance of LAB natural agent and this happened in *W. cibaria* CFS , in this test, we focused on NPs activity to indicate the significance of their broad variety of applications, as well as the use of these protection NPs as antimicrobials, this activity may be due to that lower $AgNO_3$ have benefit when used as NPs by microbes because of silver material formed polymers noticed in different applications, e.g. has a strong antimicrobial capacity against a variety of microorganisms, making it ideal for packaging. So, the presence of silver inhibits the microorganism's activity and minimizes the production of CO_2 shortly. Silver nanoparticles' antimicrobial activity is linked to their large surface area and enhanced propensity for Ag+ release[28].

Silver nanoparticles have been shown to have antimicrobial properties, because it was connected to the damage of membrane because of free radicals released from the nanoparticles' surface. Silver nanoparticles may gather in the cytoplasmic membrane, leading to increase in permeability, later on cell death[25-28].

Lee *et. al.* [7], reported that Silver is the first cause of antimicrobial activity presence the *Fusarium* many sources mentioned that effective inhibition of both Gram negative and positive bacteria (also against moderate fungi) suggests the current metabolite to be bored spectrum in nature, Barik *et. al.* results agree with present studies that support the assumption that *Fusarium oxysporum* is a rich source of functional bioactive metabolites[29].

The activity is present in the *W. cibaria* CFS that we spoke about its ability to inhibit previously, even though it is considered probiotic strain in characteristics[7,30].

The main problem of cancer gene therapy is the targeting specifically of therapeutic agents to solid tumors directly, *W. cibaria* had anticancer effect, which may be due to its ability to secrete exopolysaccharide (EPS) with anti-cancer functions, It has a higher EPS production, indicating that it is more acid modulating activity and anti-inflammatory, antioxidant activity[31,32].

Whereas Kwak *et. Al.*, registered that the anti-cancer activity in *W. cibaria* was recorded using MTT assay in which, suppression of cell growth by using *W. cibaria*, but not in normal cells, so they concluded that the effect of immune control of *W. cibaria* was higher than the known effect of probiotic bacteria, because of *W. cibaria* formed nitric oxide by high quantities, nuclear factors (NF), *W. Cibaria* is much more active than other probiotics at controlling the immune system, according to cytokines (e.g. tumor necrosis factor and interleukin-1) [33].

W. cibaria could not inhibit cervical cell lines alone, but NPs of *Fusarium oxysporum*_also have many reasons for inhibiting this type of cancer line. Some studies showed that activity of *Fusarium*

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oxysporum NPs renders to its cytotoxicity to cancer cell[34], Since nanomaterials have a high surface area to volume ratio, they have distinct chemical, physical, magnetic optical, and electrical properties, which increased operation.

NPs showed new characters depending on specific characters e.g. size, distribution and morphology, these reasons help *W. cibaria* and *Fusarium oxysporum* to inhibit the cancer cell line (Cervical cell line).

Another helping for inhibition and another factor that causes the activity of *Fusarium oxysporum* against cervical cell line is reported as potential producer of Asparaginase , which belongs to amidase group that was responsible for catalyzation L-asparagine is hydrolyzed to L-aspartic acid and ammonia., this enzyme proved to play in major role in the metabolism of cell¸ asparaginase, it is therapy agent for Acute lymphoma , has also been shown to be an efficient antilymphoma agent in humans, both acute lymphoplastic and chronic myelogenous..

Asparaginases gather lots of attention since they discovered that the enzyme from specific microbes had antitumor activity[35]. Asparaginase is useful for cancer treatment as it's interferes with growth of cancer cells, by reducing their growth. It also interferes with protein synthesis and with DNA and RNA synthesis especially in G1 phase of cell division. So, asparaginase causes death of tumor cells which are asparagine dependent induce apoptosis[36].

Also Chow *et al*, observed that asparaginase is an essential tumor controlling enzyme, and this enzyme can be developed as an anticancer compound. All these reasons together acted as strong weapons against cervical cancer [37].

It is certain and natural that all types of probiotics prove their strong efficacy because in many sources they have proven wide range of inhibition[38-39]. It is also extended to nosocomial infection[19], against parasite[21], eye pathogen[22], or against pathogenic microorganisms[40-42], and proved that it gives the strongest effect when two or more types of probiotics are combined[43]. All of the previous studies that were interested in the inhibitory effect of LAB indicated that are not failed never in its role as anti-microbial agent[44]. Both fresh and fermented vegetables are good sources of bioactive compounds[45].The highest levels of lactic acid bacteria were found in many types of vegetables like beet, cabbage, carrot and others[46]. The fermentation process contributed to the generation of large amounts of lactic acid in the vegetables[47], and provided vegetables with new functionalities like probiotic, these probiotic with all characterizations explain the reason for the inhibition activity of LAB in our study, which was supported by many studies[48]. Probiotics are not only in food but can be a treatment[49].and are not to LAB but can be yeast or other bacteria [50],despite the difference in the source , but all of them have the highest activities and have a wide range[51].

Conclusion

The study concluded that LAB can be isolated from vegetables such as Turnip, Cabbage, Beet and Cauliflower. High antibacterial activity of LAB isolated from Turnip against pathogenic bacteria such as *S. aureus* and *E.coli*, whereas less effect on *Pseudomonas*, and no effect on *Klebsiella*. The synergetic effect of combined *W. cibaria* and biosynthesized nanoparticles of *Fusarium oxysporum* have high antibacterial and good agents for anti-cervical cancer. This natural material can be considered a powerful weapon against cancer cells.

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Authors' Declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for re-publication, which is attached to the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee at University of Mustansiriyah.

Authors' Contribution Statement

This work was carried out in collaboration between all authors Y. M. B. gave the idea of the research and the steps of work N. Z. and S. Q. collected the samples and diagnosed them, H. Z. doing all the test about activity and anti-cancer, then Y. M. B. wrote the manuscript with revisions, A. M. H. diagnosed them and edited the manuscript with revisions and now take the care of publishing. All authors read and approved the final manuscript.

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التأثير التآزري لـ *Weisella cibaria* والجسيمات النانوية الحيوية من *Fusarium oxysporum* ضد خلايا سرطان عنق الرحم

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الخلاصة

من المتوقع أن يتجاوز عبء السرطان العالمي المتوقع 20 مليون حالة سرطان جديدة بحلول عام 2025. على الرغم من التقدم الأخير في علاج الأورام ، لا يزال علاج السرطان الناجح يمثل تحديًا. يوفر مجال تكنولوجيا النانو الناشئ فرصًا رائعة لتشخيص السرطان ، والتصوير ، وعلاج السرطان. يعتبر التخليق الحيوي لجسيمات الفضة النانوية عن طريق الفطريات طريقة نظيفة وغير سامة بيئيًا مقارنة بالطرق الفيزيائية والكيميائية الأخرىالغرض من هذه الدراسة هو تحديد التأثير التآزري للجسيمات النانوية المركبة من *Fusarium oxysporum* مع *Weisella cibaria* ضد خلايا سرطان عنق الرحمأجريت هذه الدراسة من عام 2022 إلى مارس 2023 في معمل ميكروبيولوجيا الغذاء في قسم الأحياء / كلية العلوم / الجامعة المستنصرية. تم عزل بكتيريا حمض اللاكتيك (LAB) من مصادر الغذاء (الشلغم ، اللهانه ، الشوندر والقرنابيط) ، بعد خطوات متسلسلة من كلوريد الصوديوم المعالج ، ثم تم تربيتها في مرق Man-)MRS Rogosa-Sharpe) ، وتم فحصها تحت المجهر. تم الكشف عن النشاط المضاد للبكتيريا في المواد الطافية الخالية من الخلايا (CFS) التي تنتجها هذه العزلات لاختيار الأفضل وتشخيصها عن طريق تسلسل تفاعل البوليميراز المتسلسل والحمض النووي. تم الحصول على الجسيمات النانوية (AgNo3) التي تم إنتاجها من *Fusarium oxysporum* بالتخليق الحيوي من مختبر الدراسات العليا للفطريات ، وتم إخضاع هذه الفطريات لاختبار السمية. تمت دراسة تأثير التآزر للجسيمات النانوية المختارة من LAB و *Fusarium oxysporum* ضد خلايا سرطان عنق الرحم.

أظهرت هذه الدراسة أن جميع مصادر الغذاء كانت غنية بـ LAB وأن أفضل نشاط مضاد للجراثيم كان مصدر اللفت ووفقًا للتشخيص الجزيئي كان *Weisella cibaria* والذي سجل في NCBI كـ (MG7865551). أظهر التأثير التآزري لـ *Weisella cibaria* والجسيمات النانوية انخفاض معدل بقاء خط السرطان بعد 72 ساعة من التعرض لهذا التأثير.

الكلمات المفتاحية: سرطان عنق الرحم، *Fusarium oxysporum*، بكتريا حامض اللاكتيك، الجزيئات النانوية، *Weissella cibaria*.