# Detection of *Neisseria Gonorrhoeae* and *Lactobacillus Acidophilus* in Women who Suffer from Reproductive System Infections and Measuring their Resistance to Antibiotics and Interleukin Levels

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## Abstract

Gonorrhea is a sexually transmitted disease (STD) caused by Neisseria gonorrhoeae (N. gonorrhoeae) infection that infects the mucous membranes lining the reproductive system, especially young women. *Lactobacillus acidophilus* is one of the important bacterial species that prefers an acidic environment, where it ferments sugars and converts them into lactic acid and hydrogen peroxide. It may work to inhibit or kill harmful microorganisms in humans, and it may be opportunistic, causing diseases in humans. a total of 200 samples including (170 vaginal swabs from patients and 30 healthy swabs samples) were collected from women who visited Al-Ammarah General Hospital in Maysan Governorate, ranging in age from 20 to 42, between October 28, 2022, and May 13, 2023. For the purpose of diagnosing and isolating *L. acidophilus* and *N. gonorrhoeae*. Visual, microscopic, biochemical, identified and tested for their antibiotic sensitivities using the Kirby-Bauer disk diffusion method was used to test the resistance and sensitivity of *L. acidophilus* and *N. gonorrhoeae* of bacterial isolates against Nitrofurantoin (F), Ceftazidime (CAZ), Azithromycin (AZM), Amikacin (AK), Ceftriaxone (CRO), Ciprofloxacin (CIP), Gentamycin (CN), Tobramycin (TOB), Tetracycline (TE) respectively, and Levofloxacin (LEV), Cefixime (CFM) respectively, by agar disc diffusion method, according to manufacture instructions and clinical and Laboratory Standards Institute (CLSI) guidelines. The clinical specimens showed that 30 (17.64%) of the total isolates were identified as *N. gonorrhoeae*. The remaining 140 samples (82%) showed negative results in laboratory culture. The results of the antibiotic susceptibility test showed that the bacteria were multidrug-resistant. In the current study, most of the *N. gonorrhoeae* isolates were 100% resistant to antibiotics for Tetracycline and Ceftriaxone, while they were less resistant at 93.33% towards Azithromycin and 90% towards Ciprofloxacin. While the resistance rate of L. acidophilus was 100% for both Ceftriaxone at a concentration of 10(µg disc) and 83.33% for a concentration of 30(µg/ disc) and 90% for Tetracycline and 66.86% for Cefepime and 70% for Imipenem, it was sensitive to most antibiotics by 100% for Vancomycin, Levofloxacin, and Ciprofloxacin, respectively, and 70% for Tobramycin, 60% for Amikacin, 53.33% for Gentamycin, and 30% and 13.33% for Imipenem and Cefepime, respectively.



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*N. gonorrhoeae* was responding to sexually transmitted diseases and became more dangerous because it resisted many antibiotics.

***Keywords:*** *sexually transmitted disease, Neisseria gonorrhoea, Lactobacillus acidophilus.*

## الكشف عن بكتيريا *Neisseria gonorrhoeae* و *Lactobacillus acidophilus* لدى النساء اللاتي يعانين من التهابات الجهاز التناسلي وقياس مقاومتهن للمضادات الحيوية ومستويات الإنترلوكينات

**رغد عبد الواحد قوبيان [1] وَ أ.د. زهرة عدنان الشمري[2]**

**الخلاصة**

السيلان هو مرض ينتقل عن طريق الاتصال الجنسي (STD) تسببه عدوى النيسرية البنية (*N. gonorrhoeae*) التي تصيب الأغشية المخاطية المبطنة للجهاز التناسلي، وخاصة النساء الشابات. تعتبر بكتيريا *Lactobacillus acidophilus* من الأنواع البكتيرية الهامة التي تفضل البيئة الحمضية، حيث تقوم بتخمير السكريات وتحويلها إلى حمض اللاكتيك وبيروكسيد الهيدروجين. وقد يعمل على تثبيط أو قتل الكائنات الحية الدقيقة الضارة لدى الإنسان، وقد يكون انتهازياً مسبباً للأمراض لدى الإنسان. تم جمع ما مجموعه 200 عينة تشمل (170 مسحة مهبلية من المريضات و30 عينة مسحة صحية) من النساء اللواتي زرن مستشفى العمارة العام في محافظة ميسان، وتراوحت أعمارهن من 20 إلى 42 سنة، في الفترة ما بين 28 تشرين الأول 2022، و13 مايو 2023، لتشخيص وعزل *L. acidophilus* و*N. gonorrhoeae*، تم تحديد اختبار حساسيتهما للمضادات الحيوية باستخدام طريقة الانتشار القرصي Kirby-Bauer لاختبار مقاومة وحساسية L. acidophilus وN. gonorrhoeae وتم التعرف على صفاتهما المجهرية والكيمياحيوية واختبارها للمضادات الحيوية باستخدام طريقة كيربي باور للانتشار القرصي لاختبار مقاومة وحساسية *L. acidophilus* و*N. gonorrhoeae* من العزلات البكتيرية ضد(F) Nitrofurantoin ، Ceftazidime (CAZ)، أزيثروميسين(AZM) ، أميكاسين(AK) ، سيفترياكسون(CRO) ، سيبروفلوكساسين(CIP) ، جنتامايسين(CN) ، توبراميسين (TOB)، تتراسيكلين (TE) على التوالي، و ليفوفلوكساسين(LEV) ، سيفيكسيم (CFM) على التوالي، بواسطة طريقة انتشار قرص الأكار، وفقًا لتعليمات التصنيع وإرشادات معهد المعايير السريرية والمختبرية.(CLSI) . أظهرت العينات السريرية أن 30 (17.64%) من إجمالي العزلات تم تحديدها على أنها *N. gonorrhoeae* وأظهرت العينات الـ 140 المتبقية (82٪) نتائج سلبية في الزرع المختبري. وأظهرت نتائج اختبار الحساسية للمضادات الحيوية أن البكتيريا مقاومة للأدوية المتعددة. في الدراسة الحالية أظهرت معظم عزلات *N. gonorrhoeae* مقاومة بنسبة 100% للمضادات الحيوية مثل التتراسيكلين والسيفترياكسون، بينما كانت أقل مقاومة بنسبة 93.33% تجاه الأزيثرومايسين و90% تجاه السيبروفلوكساسين. بينما بلغت نسبة مقاومة بكتيريا L. acidophilus 100%لكل من السيفترياكسون بتركيز 10 ميكروغرام قرص و83.33% للتركيز 30 ميكروغرام/ قرص و90% للتتراسيكلين و66.86% للسيفيبيم و70% للمضادات الحيوية. كان الإيميبينيم حساسًا لمعظم المضادات الحيوية بنسبة 100% للفانكومايسين والليفوفلوكساسين والسيبروفلوكساسين على التوالي، و70% للتوبراميسين، و60% للأميكاسين، و53.33% للجنتاميسين، و30% و13.33% للإيميبينيم والسيفيبيم على التوالي*N. gonorrhoeae* . احد الأنواع البكتيرية المصنفة ضمن البكتريا المسببة للأمراض المنقولة جنسيا وأصبحت أكثر خطورة لأنها تقاوم العديد من المضادات الحيوية.

***الكلمات المفتاحية:*** *الأمراض المنقولة جنسيا، النيسرية البنية، الملبنة الحمضية.*



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## Introduction

*Neisseria gonorrhoeae (N. gonorrhoeae*) is a gram-negative diplococcus, an obligate human pathogen and the causative agent of gonorrhoea. The World Health Organization (WHO) estimates that there are 78-87 million new cases of gonorrhoea annually [1]. The WHO recommends periodic assessments of the prevalence of gonorrhoea in the general population, including pregnant women, women attending family planning clinics, military recruits, and populations at increased risk [2]. A lactic acid bacterium (LAB) is the predominant bacteria in the healthy women's vagina, playing an important role in maintaining ecological balance in the female reproductive tract [3]. *Lactobacillus* plays a protective role in the vaginal microenvironment, and a decrease in its number leads to a disturbance in microbial species and a decrease in microbial diversity in the vaginal area, which is called dysbiosis [4].

## Material and Methods

- Collection of specimens

One hundred and seventy (170) vaginal swabs were collected from female patients who had vaginal discharge, which appeared watery in appearance and green or yellow in color, pain during urination, and some of them suffered from lower abdominal pain and bleeding from the uterus during the menstrual period. The samples were collected from women who visited Al-Amara General Hospital in Maysan province, ranging in age from (20-42) years, during the period from 28-10-2022 to 15-3-2023. All swabs were placed in a transport medium and immediately transported to the laboratory in a refrigerated box for the purpose of diagnosing and isolating *L. acidophilus* and *N. gonorrhoeae* bacteria.

- Bacterial isolates

A-Morphological examination: Selective and rich culture media (blood agar, MacConkey agar, chocolate agar, Lactobacilli MRS agar, and Thayer-Martin medium) were used to study the phenotypic patterns (such as shape, color, size, and odor of colonies) as well as their ability to degrade blood, if present, for *L. acidophilus* and *N. gonorrhoeae* bacteria [5 and 6].

B-Microscope Examination

1. Direct smear (Moist dry) using 0.85% normal saline [7].

2. Dry bacterial smear: was used Gram stain to detect the bacteria *L. acidophilus* and *N. gonorrhoeae,* which were isolated on culture media [5].

C. Biochemical Tests: conducted the following biochemical tests to diagnose isolates of *L. acidophilus* and *N. gonorrhoeae* bacteria; Catalase Test [8], Oxidase Test [9], and Motility Test [8]; which Confirmation of diagnosis using the diagnostic system by VITEK 2 system.



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D. Antibiotics susceptibility test: The Kirby-Bauer disk diffusion method, according to the reference [10], was performed to test the resistance and sensitivity of *L. acidophilus* and *N. gonorrhoeae* bacterial isolates in the current study.

E. Determination on Interleukins using sera samples

1. Measurement of Human IL-6**:** the diagnostic tool provided by Human Interleukin 6 ELISA KIT, Bioassay Technology Laboratory, Shanghai, China.

2. Determination of Human IL-8: the diagnostic tool provided by Human Interleukin 8 ELISA KIT, Bioassay Technology Laboratory, Shanghai, China

3. Determination of Human IL-10: the diagnostic tool provided by Human Interleukin 10 ELISA kit, Bioassay Technology Laboratory, Shanghai, China.

## Results and discussion

**Isolation and Identification:** A total of 170 vaginal swab samples were collected from female patients who suffered from watery vaginal discharge with a green or yellow color, pain or burning during urination and some of them experienced lower abdominal pain and bleeding from the uterus during menstruation. The samples were collected from women who visited Al-Ammarah General Hospital in Maysan Governorate, ranging in age from 20 to 42, between October 28, 2022, and May 13, 2023. All swabs with a pH of 3.8 to 5.5 were immediately transported in a cooler box to the laboratory for the purpose of diagnosing and isolating *L. acidophilus* and *N. gonorrhoeae*. Visual, microscopic, and biochemical tests were performed, and 30 (17.64%) of the total isolates were identified as *N. gonorrhoeae*. The remaining 140 samples (82.35%) showed negative results in laboratory culture, as shown in Table (1).

**Table (1):** Laboratory culture results for study samples.

| Number of Negative Sample ( % ) | Number of Positive Sample ( % ) | Total ( 100) |
|---|---|---|
| 140 (82.35) | 30 (17.64) | 170 (100) |



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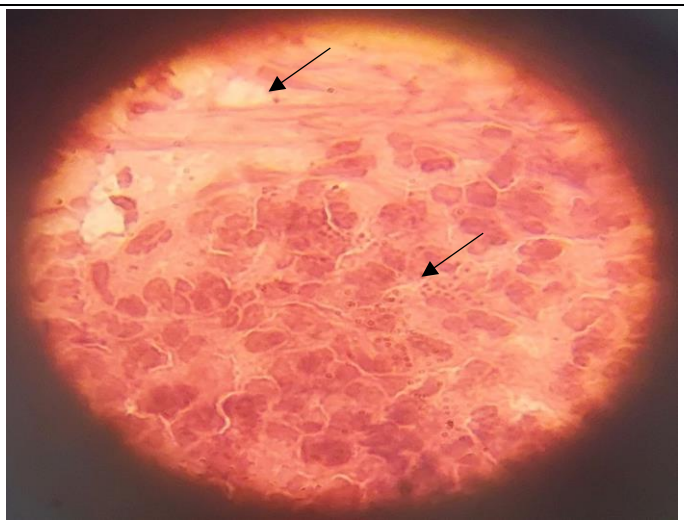

**Fig.(1):** *N. gonorrhoeae* are seen in the microscopic examination after staining the sample with Gram stain (under oil immersion 100X), in a coffee-bean-like shape, diplococcus, inside PMN cells (intracellular) or outside PMN cells (extracellular).

The current study was somewhat similar to the results of other studies. Farooq and others found in 2023 that the percentage of *N. gonorrhoeae* and *L. acidophilus* were 6 (13%) and 1 (2.2%) respectively in vaginal swabs of Iraqi women suffering from very little or no vaginal discharge with minimal pelvic pain. The researchers also found that those bacteria (*N. gonorrhoeae*) were prevalent among women despite having no symptomatic vaginal infection and their ages ranged from 21 to 47 years, which helps in the sexual transmission of the bacteria [14]. Several studies have shown that the incidence rate of gonorrhoea infection in women aged (15-5.6) years ranged from 0% to 4%, and the pH value was (4-5.6) in vaginal secretions [15].

**The spread of *Neisseria gonorrhoeae* infection according to age groups**

The current study estimates that the infection has been recorded in adult women aged between (20-50) years with a percentage of (10-60%) (Table2 ). The percentage of miscarriages among them was between (10-50%) and the number of miscarriages ranged from (1-4) times. However, these women did not suffer from infertility as the number of children they had ranged from 1 child to 6 children with a percentage of (3.33-26.67) %. The infection with these bacteria was also found in two patients who had chronic diseases such as hypertension and diabetes with a percentage of 6.67%, and 26 patients (86.67%) who did not suffer from any chronic disease as shown in Table 2.



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**Table (2):** The distribution of *N. gonorrhoeae* infection according to age groups.

| Parameters | Categories | No. | % |
|---|---|---|---|
| **Age** | 20-30 | 18 | 60 |
| | 31-40 | 9 | 30 |
| | 41-50 | 3 | 10 |
| **Miscarriage times** | 0 | 7 | 23.3 |
| | 1 | 15 | 50 |
| | 2 | 5 | 16.7 |
| | 4 | 3 | 10 |
| **Number of Children** | 0 | 2 | 6.67 |
| | 1 | 1 | 3.33 |
| | 2 | 6 | 20 |
| | 3 | 8 | 26.67 |
| | 4 | 8 | 26.67 |
| | 5 | 3 | 10 |
| | 6 | 2 | 6.66 |
| **Chronic diseases** | None | 26 | 86.67 |
| | Diabetes | 2 | 6.66 |
| | Diabetes and blood pressure | 2 | 6.67 |
| **Address** | Rural area | 6 | 20 |
| | City | 24 | 80 |

After studying the presence of *Neisseria gonorrhoeae* in cervical secretions, it was found that the infection rate was 3.13% among women aged 20-30 and 30-40 years old residing in Baghdad province [16]. However, the results of researchers Ali and Ghaima in 2022 showed that the highest infection rate with *N. gonorrhoeae* was among women aged 36-45 years old with an infection rate of 4% [17]. This does not coincide with the results of the current study. The results have shown that many women have vaginal secretions, lower abdominal and pelvic pain during childbirth, and their children are suffering from eye inflammation. There is a high probability that these women are infected with gonorrhoea, but the absence of screening and lack of proper treatment during pregnancy may lead to the spread of bacteria and the birth of infected children as well [18].

**Cultural characteristics of *N. gonorrhoeae***

Colonies of *N. gonorrhoeae* appeared on the blood agar after 24-hour and 48-hour incubation at a temperature of 37 C° in the form of smooth, round, moist colonies with regular edges, and their color tends to grey-white. It was observed that the growth of bacteria on the blood agar was weak during the first 24 hours of incubation, so the culture media was left for another 24 hours, and the growth appeared better with the formation of an unacceptable odor (figure 2). This has been confirmed by many researchers, and it may be due to the fact that Brown *Neisseria* is the most



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sensitive type and requires the addition of growth-stimulating substances complex growth media because it is highly susceptible to toxic substances such as fatty acids, and unable to grow in normal blood vessels [19].

Colonies of *N. gonorrhoeae* appeared on the chocolate agar after 24 hours of incubation at a temperature of 37 ℃ and in the presence of 5-10% $CO_2$, small greyish-white, mucous, smooth, with defined non-zigzag edges defined margins (figure 3) and table (2). The results of the current study were consistent with the results of other researchers, as the studies confirmed that chocolate agar is a rich medium used to support the growth of gonorrhoea bacteria, which are highly sensitive to dehydration and need special growth boosters. Some strains belonging to *N. gonorrhoeae* may appear there have some differences when growing on the chocolate agar medium, depending on the presence of pili and opacity proteins, but in general they need X-factor (Hemin) and V-Factor (represented by NAD) for their growth, growth appears more intense, and colonies are larger on the chocolate medium compared to blood Agar with a pH of 7-7.2, as *N. gonorrhoeae* can grow in relatively wide pH ranges (5.8-8), but their growth is abundant in moderate pH ranges [20].

The colonies of *N. gonorrhoeae* on the Modified Thayer-Martin agar appeared small, white-grey in color, tending to colorless greyish-white to colorless, mucous with irregular edges and with a diameter ranging from 0.5 to 1 mm (figure 4) and a table (2). The results of the current study have come in line with many international studies, and the Thayer - Martin agar is the hub of the selective culture media important in isolating the bacteria of sexual gonorrhoea because it contains four types of antibiotics (Polymyxin, vancomycin, trimethoprim, and nystatin) which helps inhibit the growth of Gram-positive and Gram-negative bacteria except *Neisseria*, as well as the presence of Nystatin that helps to kill fungi [21]. The inability of the bacteria under study to move in a semi-solid medium for movement examination is an indication that these bacteria are non - motile and this has been proven by many international studies [22].

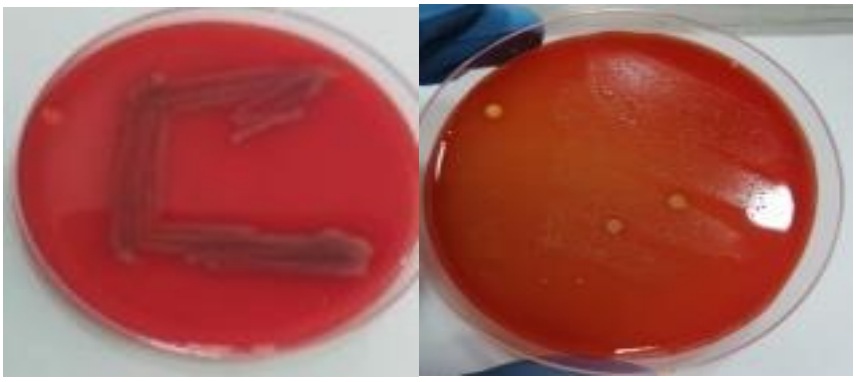

**Fig. (2):** colonies of *N. gonorrhoeae* on the blood agar after 48 hours incubate at a temperature of 37 C and provide 5-10% $CO_2$ in a candle jar.



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**Fig. (3):** Colonies of *N. gonorrhoeae* on the chocolate agar after 48 hours incubate at a temperature of 37 ℃and provide 5-10% $CO_2$ in a candle jar.

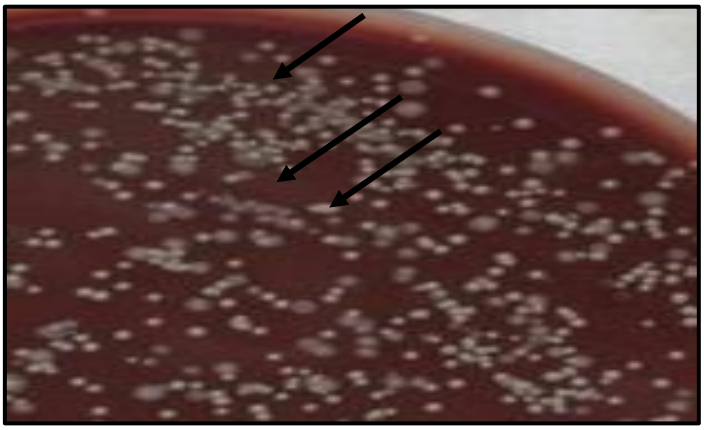

**Fig. (4):** Colonies of *N. gonorrhoeae* on the Thayer-Martin agar after 24-hour incubation with a temperature of 37 ℃.

**Table (3):** Culture traits of *N. gonorrhoeae* in an enriched and selective culture medium. These specifications are internationally known for these types of bacteria.

| Chocolate Agar Medium (CAM) | Thayer Martin Medium | Blood Agar Medium (BAM) | Culture Characters |
|---|---|---|---|
| Round | Round | Round | Shape |
| 1 -2 mm | 1-3 mm | 1-2 mm | Size |
| Convex | Convex | Convex | Elevation |
| Smooth | Smooth | Smooth | Surface |
| Colorless to Grey | Colorless to Grey | Grey | Color |
| Opaque | Transparent or Opaque | Opaque | Structure |
| γ – Hemolysis (No hemolysis) | γ – Hemolysis (No hemolysis) | γ – Hemolysis (No hemolysis) | Hemolysis |



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**Cultural characteristics for *L. acidophilus***

The *L. acidophilus* colonies were distinguished on the blood agar after a 24hour incubation at a temperature of 37 m with its small size, grey in color, with the production of hemolysis of type alpha, on the medium of chocolate agar, the growth of colonies appeared very weak, while the best growth was with high purity on the medium of agar, as the colonies appeared round-shaped, small-sized convex smooth, shiny, some of them were white, others tended to cream color (figure 5). It was found that all isolates growing on the nutrient agar medium of Agar appeared their colonies white-creamy, smooth and with smooth edges (figure 6). Other mixed bacterial colonies with *L. acidophilus* appeared in the initial isolation on the medium of blood agar and nutrient agar, it was found that most of these species belonged to *Escherichia coli*. As well as other species belonging to the genus *Lactobacillus* as the type *L. plantarum*, *L. paracasel* and *L. fermentum*, the diagnosis of which was confirmed using the VITEK2.

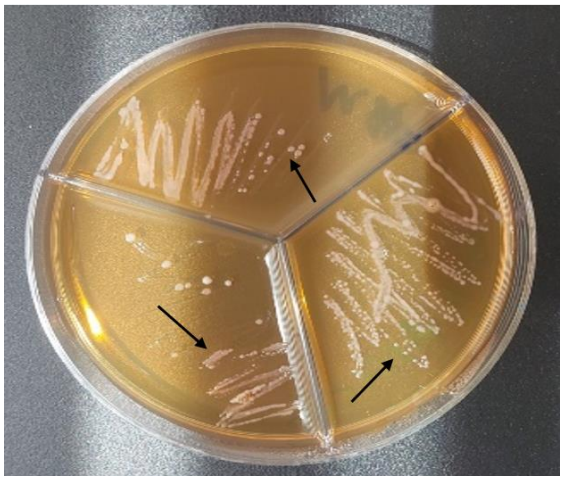

**Fig. (5):** *L. acidophilus* colonies are white in color on the MRS agar.

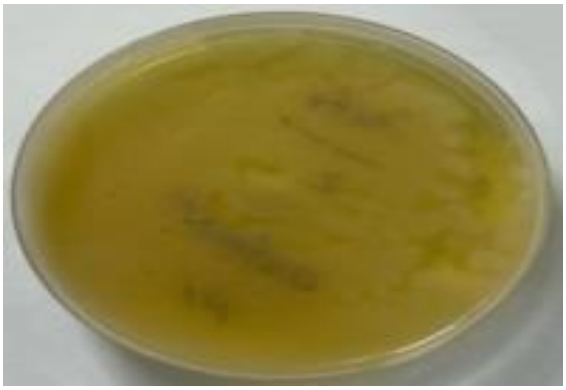

**Fig. (6):** *L. acidophilus* colonies on the nutrient agar medium in which a smooth white- cream color appears.



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**Antibiotic sensitivity tests for *N. gonorrhoeae* and *L. acidophilus* isolates**

An Antibiotic sensitivity test for *N. gonorrhoeae* isolates was carried out against several antibiotics. The results of this study were consistent with other Iraqi and global studies, which found that *N. gonorrhoeae* and *L. acidophilus* were highly resistant to antibiotics under study and showed moderate sensitivity to other antibiotics (Table 4). In the current study, most of the *N. gonorrhoeae* isolates were resistant to antibiotics at a rate of 100% for both Tetracycline and Ceftriaxone, while the resistance rate was lower at 93.33% for Azithromycin and 90% for Ciprofloxacin. These results are in agreement with the findings of Magnus and William, 2015. Fortunately, fluoroquinolones such as ciprofloxacin were highly effective against gram-positive cocci, providing treatment options. While the rates varied for the rest of the antibiotics, most of them were sensitive, with 93.3% for Amikacin, 86.66% for Levofloxacin, 100% for Vancomycin, and 83.33% for Tobramycin, thus agreeing with the results obtained in the current study and those obtained by a number of specialized researchers [23]. While the resistance rate of *L. acidophilus* was 100% for both Ceftriaxone at a concentration of 10(µg disc) and 83.33% for a concentration of 30(µg/ disc) and 90% for Tetracycline and 66.86% for Cefepime and 70% for Imipenem, it was sensitive to most antibiotics by 100% for Vancomycin, Levofloxacin, and Ciprofloxacin, respectively, and 70% for Tobramycin, 60% for Amikacin, 53.33% for Gentamycin, and 30% and 13.33% for Imipenem and Cefepime, respectively (Table 5). These results are consistent with those of other researchers in Australia and Germany [24 and 25].



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**Table (4):** Antibiotic sensitivity test on clinical isolates of *Neisseria gonorrhoeae.*

| Antibiotic / Isolate | AK 10 | AZM 15 | CIP 10 | CRO 10 | CN 10 | LEV 5 | VA 5 | TE 10 | TOB 10 | CRO 30 | CFM | IMI | Percentage of Resistance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | S | S | S | R | S | S | S | R | S | R | R | R | 50% |
| P2 | R | S | S | R | S | S | S | R | S | R | R | R | 60% |
| P3 | S | S | S | S | R | S | S | R | R | R | R | S | 60% |
| P4 | S | S | S | R | R | S | S | R | R | R | R | R | 70% |
| P5 | R | S | S | R | R | S | S | R | R | R | R | R | 80% |
| P6 | S | S | S | R | R | S | S | R | S | R | R | S | 60% |
| P7 | S | S | S | R | S | S | S | R | S | R | R | R | 50% |
| P8 | S | S | S | R | S | S | S | R | S | R | R | R | 50% |
| P9 | S | S | S | R | R | S | S | R | S | R | R | S | 60% |
| P10 | R | S | S | R | R | S | S | R | S | R | R | R | 70% |
| P11 | R | S | S | R | R | S | S | R | S | R | R | R | 60% |
| P12 | R | S | S | R | R | S | S | S | R | R | R | S | 80% |
| P13 | R | S | S | R | R | S | S | R | R | R | S | R | 80% |
| P14 | R | S | S | R | R | S | S | R | R | R | R | R | 80% |
| P15 | R | S | S | R | S | S | S | R | R | R | R | R | 70% |
| P16 | R | S | S | R | S | S | S | S | R | R | R | R | 70% |
| P17 | R | S | S | S | S | S | S | R | R | R | R | R | 60% |
| P18 | S | S | S | R | S | S | S | R | S | R | R | R | 50% |
| P19 | S | S | S | R | S | S | S | R | S | R | S | S | 50% |
| P20 | S | S | S | S | S | S | S | R | S | R | R | S | 40% |
| P21 | S | S | S | R | S | S | S | S | S | R | R | R | 50% |
| P22 | S | S | S | R | S | S | S | R | S | R | S | R | 50% |
| P23 | S | S | S | R | S | S | S | R | S | R | R | R | 50% |
| P24 | S | S | S | R | R | S | S | R | S | R | R | R | 60% |
| P25 | S | S | S | S | R | S | S | R | S | R | S | S | 50% |
| P26 | R | S | S | R | R | S | S | R | S | R | R | R | 60% |
| P27 | R | S | S | S | R | S | S | R | S | R | R | R | 60% |
| P28 | R | S | S | R | S | S | S | R | S | R | R | S | 50% |
| P29 | R | S | S | R | S | S | S | R | S | R | R | R | 60% |
| P30 | R | S | S | R | S | S | S | R | S | R | R | S | 60% |



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**Table (5):** Antibiotic sensitivity test on clinical isolates of *L. acidophilus.*

| Antibiotic / Isolate | AK 10 | AZM 15 | CIP 10 | CRO 10 | CN 10 | LEV 5 | VA 5 | TE 10 | TOB 10 | CRO 30 | Percentage of Resistance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | S | R | S | R | S | S | S | R | S | R | 40% |
| P2 | S | R | S | R | S | S | S | R | S | R | 40% |
| P3 | S | R | S | R | S | S | S | R | S | R | 40% |
| P4 | S | R | S | R | R | S | S | R | S | R | 50% |
| P5 | S | S | S | R | R | S | S | R | S | R | 40% |
| P6 | S | R | S | R | S | S | S | R | S | R | 40% |
| P7 | R | R | R | R | S | R | S | R | S | R | 80% |
| P8 | S | S | S | R | R | S | S | R | S | R | 40% |
| P9 | R | R | S | R | R | R | S | R | S | R | 70% |
| P10 | S | S | S | R | S | S | S | R | S | R | 30% |
| P11 | S | S | S | R | S | S | S | R | S | R | 30% |
| P12 | S | R | S | R | S | S | S | R | S | R | 50% |
| P13 | R | R | R | R | S | R | S | R | S | R | 70% |
| P14 | S | R | R | R | S | R | S | R | S | R | 60% |
| P15 | S | R | S | R | S | S | S | R | S | R | 40% |
| P16 | S | R | S | R | S | S | S | R | S | R | 40% |
| P17 | S | R | S | R | S | S | S | R | S | R | 40% |
| P18 | S | R | S | R | S | S | S | R | S | R | 40% |
| P19 | S | R | S | R | R | S | S | R | S | R | 50% |
| P20 | S | R | S | R | S | S | S | R | S | R | 40% |
| P21 | S | R | S | R | S | S | S | R | S | R | 40% |
| P22 | S | R | S | R | S | S | S | R | S | R | 40% |
| P23 | S | R | S | R | S | S | S | R | S | R | 40% |
| P24 | S | S | S | R | S | S | S | R | S | R | 40% |
| P25 | S | S | S | R | S | S | S | R | S | R | 30% |
| P26 | S | S | S | R | S | S | S | R | S | R | 30% |
| P27 | S | S | S | R | S | S | S | R | S | R | 30% |
| P28 | S | S | S | R | R | S | S | R | S | R | 40% |
| P29 | S | R | S | R | S | S | S | R | S | R | 40% |
| P30 | S | R | S | R | S | S | S | R | S | R | 40% |

**Mean of different Interleukins between studied groups**

From the results of the current study, the levels of IL-6, IL-8, and IL-10 in the serum of women infected with *N. gonorrhoeae* appeared high compared with the Control group (Table 6 and Figure 7): 47.11±1.69 vs7.09±1.12; p=0.0001 for interleukin 6 (IL-6), 1615±197.16 vs 311.47±14.63; p=0.0001 for interleukin 8 (IL-8), and 164.50±17.24 vs 41.71±3.03; p = 0.0001 for interleukin 10 (IL-10).



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**Table (6):** Average level of interleukins in women infected with N. gonorrhoeae compared with the control group.

| Parameters | Mean±S.E | | p. value |
|---|---|---|---|
| | **Control (NO=30)** | **Patients (NO=30)** | |
| IL-6(pg/ml) | 7.09±1.12 | 47.11±1.69 | 0.0001 |
| IL-8(pg/ml) | 311.47±14.63 | 1615.53±197.16 | 0.0001 |
| IL-10(pg/ml) | 41.71±3.03 | 164.50±17.24 | 0.0001 |

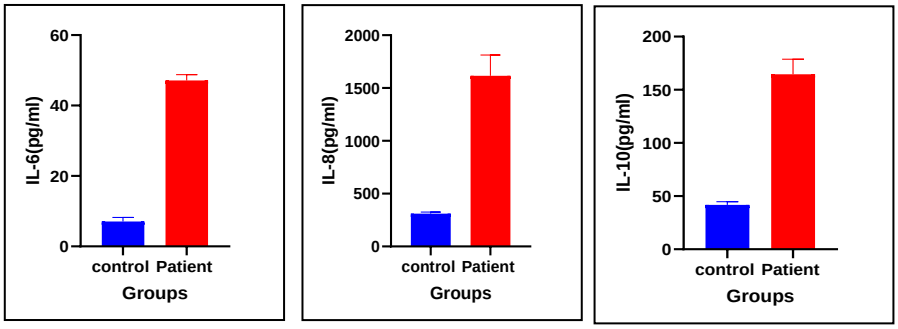


**Fig. (7):** Levels of IL-6, IL-8, and IL-10, compared with the control group in women infected with *N. gonorrhoeae*

Host defenses against *N. gonorrhoeae* are regulated in part by cytokines produced by lymphocytes, phagocytes, and epithelial cells. Inflammatory cytokines, such as IL-6, IL-8, and IL-10, are produced in local secretions and serum during mucosal infections in which *N. gonorrhoeae* is present. The results of the current study are fully consistent with the results of international studies. Epithelial cells are the main source of IL-6 and IL-8 production during the acute stages of the disease, which are products of the immune response against *N. gonorrhoeae*, leading to vasodilation and prostaglandin production [26].



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