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Study of the Antimicrobial Effect of Jojoba and Wheat Germ Oils in Vitro

Noor Alhouda Mohammed Alghazzawi[1], Dr. Hassan Al Khouri[2], Dr. Bachar Alazzam[3]

[1,2,3] Faculty of pharmacy Aljazeera private university. Syria

ABSTRACT: Since ancient times, vegetable oils have been used in treating many diseases.

Studies have shown the therapeutic potential of jojoba and wheat germ oils.

The uses of jojoba oil include the following conditions: treating eczema and psoriasis, treating acne and sunburn cases, combating aging, moisturizing the hair, and treating dandruff and psoriasis on the scalp.

As for wheat germ oil, its benefits include maintaining the body's natural functions, maintaining the health of the digestive system, enhancing energy production, boosting immunity, reducing the risk of cardiovascular diseases, and promoting muscle health. Additionally, it slows down aging and prevents hair loss.

This article briefly sheds light on the jojoba plant and wheat germ and their active components, while most of this research is focused on the antimicrobial effect of jojoba and wheat germ oils.

KEYWORDS: (treatment, activity, Jojoba oil, Wheat germ oil, Escherichia coli, Staphylococcus aureus)

FIRST: JOJOBA PLANT

Introduction

The jojoba plant belongs to the family Simmondsiaceae and is a perennial wild plant that produces seeds like peanut seeds.

The economic value of this plant, which contains 40-60% pure oil by weight, has been recognized for several years.

This oil is used to treat various skin and scalp conditions, including acne, psoriasis, eczema, sunburn, moisturizing hair, and dandruff, as well as psoriasis on the scalp. Additionally, it possesses antimicrobial properties [(1)(6).]

Jojoba oil is a variable byproduct whose composition depends on the efficiency of oil extraction and the presence of seed shells.

As a result, protein concentration ranges from 20% to more than 30% dry matter, while oil content ranges from less than 1% to 15% dry matter.

The crude fiber content ranges from 8% to 15% dry matter.

Jojoba protein is relatively rich in lysine (approximately 6% of the protein).

Jojoba oil is extracted from the seeds found in the fruit using cold pressing and/or chemical methods.

Approximately half of the seed consists of oil, making it relatively easy to extract chemically [(5)]

Native Americans have used jojoba oil for centuries to treat skin and scalp disorders, as well as for wound care.

Studies indicate that it is beneficial for individuals suffering from acne, psoriasis, and sunburn, and may help prevent certain bacterial infections.

Research on jojoba oil in humans is limited; however, it has been used for hundreds of years to treat various skin conditions.

Laboratory tests and studies conducted on animals suggest that the benefits of jojoba oil form the skin come from its unique composition of plant waxes and antioxidants [(6)]

Active Ingredients

The oil is usually golden or light yellow in color and does not spoil due to its high level of antioxidants (natural compounds that protect against cell damage).

Jojoba oil consists of a mixture of jojoba wax, free fatty acids, alcohols, and molecules known as sterols (such as cholesterol), as well as with antioxidants and fat-soluble vitamins.

Approximately 79% of the vitamins present in jojoba oil are vitamin E.

It is also important to note that jojoba wax is very similar to the sebum secreted by human skin, which is the oil produced by the skin to keep it moist and elastic.

Because jojoba oil is very similar to sebum and contains a high percentage of vitamin E, it is an excellent skin moisturizer that can soften dry skin, prevent flaking, and improve skin elasticity [(6)]

The fatty acid content of jojoba oil can vary significantly depending on the soil and climate in which the plant grows, as well as the timing of the harvest and the method of oil processing.
Generally, it has a high content of monounsaturated fatty acids, particularly 11-eicosenoic acid (gondoic acid).
In addition, the seeds contain high levels of simmondsin and simmondsin analogs.
Simmondsin is a cyanogenic glycoside that is highly toxic to rats, mice, rabbits, and sheep.
Jojoba contains phenolic compounds and has a bitter taste [(5).]

SECOND: WHEAT PLANT

Introduction

Wheat is an important source of carbohydrates.
Globally, it is the main source of plant-based proteins in human nutrition, with a protein content of about 13%, which is relatively high compared to other major grains but relatively low compared to protein quality (availability of essential amino acids).
When consumed as a whole grain, wheat is a source of nutrients and dietary fiber. [(11)]
The wheat germ is essentially the embryo of the seed, from which the entire crop sprouts.
Unlike refined grains that lose their original nutritional value, the germ contains huge reserves of healthy compounds, which are retained in oil, which are obtained through the processes of pressing and extracting the grain.
There are many benefits to wheat germ.
It is not food that can be eaten alone, but there are several ways that patients can incorporate it into their diet, including: maintaining normal body functions, maintaining the health of the digestive system, boosting energy production, enhancing immunity, reducing the risk of cardiovascular disease, enhancing muscle health.
Additionally, wheat germ oil slows down aging and prevents hair loss. [(24)(23)]
The benefits of octacosanol - a long-chain fatty acid with an alcoholic component in wheat germ oil - help build strength in the body's core muscles, along with significantly increasing endurance and flexibility.
Consuming wheat germ oil supplements once daily an hour before exercise significantly enhances performance in physical activities. [(24)]

Active Ingredients

Wheat germ is a concentrated source of many essential nutrients.
It contains vitamins [A, D, K, E], folic acid, phosphorus, thiamine, zinc, and magnesium, as well as essential fatty acids and fatty alcohols. Also, it is a good source of fibre.
Furthermore, wheat germ oil contains large amounts of powerful antioxidants, antimicrobials and anti-inflammatory agents.
These components provide many benefits to improve overall health, ranging from enhancing heart function and improving human endurance levels, to noticeable improvement in skin health and promoting hair growth. [(18)(24)]

Antimicrobial Effects

One study shows that jojoba oil inhibits the growth of various bacteria, including Staphylococcus aureus, which can cause skin infections.
Since jojoba oil contains high levels of vitamin E and antioxidants, it may help heal wounds quickly and prevent scar formation. [6]
Additionally, studies have shown that wheat germ extract exhibits antimicrobial efficacy at various concentrations against several bacteria, including Listeria, Salmonella, Staphylococcus, and other bacteria. [25]
The results of the tests conducted to confirm the antimicrobial effect of jojoba and wheat germ oils showed that they have an antimicrobial property.
Jojoba oil affected both Gram-positive and Gram-negative bacteria, while wheat germ oil had an effect only on Gram-positive bacteria.

MATERIALS AND METHODS:

First: Oil Dilution

To determine the concentration of the oils, we weighed 100 microliters of each oil as follows:
Plastic test tubes with a capacity of 15 ml were used, and their initial weights were recorded when empty:
The first tube: 770 mg
The second tube is 770 mg
- 100 microliters of jojoba were added to the first tube.
- Also add 100 microliters of wheat germ to the second tube.
- The two tubes were weighed after adding the oil, and they were in order.

First tube: 880 mg
Second tube: 850 mg

The difference in weight was calculated for each tube separately, so the weight difference in the first tube was 110 mg, and in the second tube 80 mg, which represents 100 microliters of jojoba and 100 microliters of wheat germ, respectively.
At this point, it was necessary to convert these weights to micrograms, and we use a special diluent called dimethyl sulfoxide (DMSO).
For every 90.9 microliters of oil, we added 909.1 microliters of DMSO, resulting in concentrations of 110,000 micrograms/ml for jojoba oil and 80,000 micrograms/ml for wheat germ oil after dilution.
From these test tubes, we took 90.9 microliters to two new test tubes and added 909.1 microliters of DMSO to them.
This resulted in concentrations of 11,000 micrograms/ml for jojoba oil and 8,000 micrograms/ml for wheat germ oil, respectively.

Obtaining Required Concentrations

Jojoba Oil

• To achieve a concentration of 1600 micrograms/ml of jojoba oil:
- 100 microliters from the last jojoba tube were added to 525 microliters of DMSO.
The final volume becomes 625 microliters, and the dilution factor is 6.875 (since the concentration = 11000 / 6.875 = 1600 microliters/ml).
• To achieve a concentration of 800 microliters/ml:
- 50 microliters were taken from the oil tube and diluted with 575 microliters of DMSO.
Thus, the oil was diluted by a factor of 13.74, resulting in a concentration of 13.74/11000 = 800 microliters/ml.
• To achieve a concentration of 400 microliters/ml:
- 500 microliters were taken from the tube containing the concentration of 800 microliters/ml.
- 500 microliters of DMSO were added, resulting in a final concentration of 400 microliters/ml.
• Finally, to obtain a concentration of 200 microliters/ml:
- 500 microliters were taken from the tube containing the 400 micrograms/ml concentration.
- 500 microliters of DMSO were added.
The concentration becomes 200 microlitres/ml, which is the desired concentration.

Wheat germ oil

• In order to obtain a concentration of 1600 microliters/ml of wheat germ oil:
- 100 microliters of wheat germ from the last tube were added to 400 microliters of DMSO.
The final volume is 500 microliters, and the dilution factor is 5 (Where concentration = 8000/5 = 1600 microliters/ml)
• In order to obtain a concentration of 800 microliters/ml:
- 50 microliters of oil were taken from the tube, and we added 450 microliters of DMSO to it.
Thus, the oil is diluted 10 times.
The concentration became equal to 8000/5 = 800 microliters/ml.
• In order to obtain a concentration of 400 microlitres/ml:
- 500 microliters were taken from the tube containing the concentration of 800 microliters/ml.
- 500 microliters of DMSO are added, and the concentration becomes 400 microliters/ml.
• Finally, to obtain a concentration of 200 microliters:
- 500 microliters were taken from the tube containing the concentration of 400 microliters/ml.
- 500 microliters of DMSO were added.
The concentration becomes 200 microliters/ml, which is the desired concentration.

Second: Preparation of Samples

A bacterial suspension was prepared from E. coli obtained from a patient with urinary tract infection.
The urine was cultured on two media:
1. Blood Agar Medium
2. Another medium is MacConkey Agar medium.
- The two media were incubated at 37°C for 24 hours.
Bacterial growth was observed in both media, and it was noted that growth on MacConkey medium gave the highest. Colonies of a light red color. The nature of these colonies is dry.
Two tests were performed on these colonies: the Methyl Red test and the Indole test.
The bacteria produced a red ring after adding Kovac's reagent to the tube containing them after incubation, indicating a positive Indole test.
Additionally, several drops of Methyl Red indicator were added to the other tube for the Methyl Red test, which turned red, confirming a positive result.
A colony was then cultured on Simmons' Citrate Agar.
After incubation, the color remained green, indicating a negative result for citrate utilization.

Based on these previous tests, we conclude that the bacteria are Escherichia coli.
After this test:
• Several colonies were taken and placed in a sterile physiological serum.
• The absorbance was measured at a wavelength of 600 nanometers using a
spectrophotometer and compared with the absorbance of a standard solution made from barium chloride known as 0.5 McFarland.
• After that, the number of added colonies increased until the absorbance of the tube containing the bacteria was approximately equal to that of the 0.5 McFarland standard.
• This tube was then streaked using a sterile cotton swab onto a solid medium containing Mueller-Hinton Agar.
• After waiting for a few minutes, tablets containing the following antibiotics were added:
• Cloxacillin as a negative control
• Amikacin as a positive control (based on previous experiments regarding the effect of different antibiotics).
• Circular filter paper discs approximately 0.5 cm in diameter were cut.
• One of these discs was soaked with 25 micrograms of jojoba oil, and the other with 25 micrograms of wheat germ oil.
• The previously mentioned discs were placed sequentially on the surface of the agar after streaking the bacterial suspension on it.
After waiting for a few minutes, the plate was incubated upside down in an incubator at 37 degrees Celsius for only 24 hours.
On the following day, the diameters of non-growth circles were measured for cloxacillin, amikacin, jojoba oil, and wheat germ oil were measured and recorded these results.
A bacterial suspension was prepared from Staphylococcus aureus taken from a sick person suffering from impetigo (soft tissue infection).
The sample was cultured on two media:
1. Chapman Medium
2. Mueller-Hinton Medium
Incubation was done at 37°C in 24 hours, and bacterial growth was observed in both media.
Growth was observed in Chapman's medium, which produced colonies that turned the color of the medium yellow.
- In order to confirm the identity of the germs.
To confirm the identity of the bacteria, Chapman Medium, which contains mannitol and sodium chloride at a high concentration (approximately 75 grams/liter), is differential for Staphylococcus aureus because only it can ferment mannitol, resulting in a color change from red to yellow due to acid production from mannitol metabolism, which reduces the pH of the phentol red indicator.
After this test:
Several colonies were taken and placed in sterile physiological serums.
- The absorbance was measured at a wavelength of 600 nm using a spectrophotometer and the absorbance was compared with the absorbance of a synthetic turbidity made of barium sulfate known as 0.5 McFarland.
- After that, the number of added colonies increased until the absorbance of the tube containing the bacteria became approximately equal to that of a 0.5 McFarland tube.
The tube was taken and part of it and streaked using a sterile cotton swab on a solid medium containing Mueller-Hinton Medium.
Waiting for a few minutes, tablets containing the following antibiotics were added:
Positive control: Trimethoprim with Sulfametoxazole.
Negative control: Amoxicillin.
Circular filter paper discs approximately 0.5 cm in diameter were cut, and one of these discs was soaked with 25 micrograms of jojoba oil and the other with 25 micrograms of wheat germ oil.
The previously mentioned discs were placed sequentially on the surface of the Mueller-Hinton Medium after streaking the bacterial suspension on it.
After waiting a few minutes, the discs were incubated upside down in the incubator at 37 degrees Celsius for 24 hours.
The next day, the diameters of the no-growth circles were measured for trimethoprim, sulfametoxazole, amoxicillin, jojoba oil, and wheat germ oil, and these results were recorded.

RESULTS:
1 Results of E. coli sensitivity to jojoba and wheat germ oils:
The diameters of the non-growth circles were as follows:
-Amikacin 23 mm
- Jojoba oil 19mm
- Wheat germ oil 0 mm

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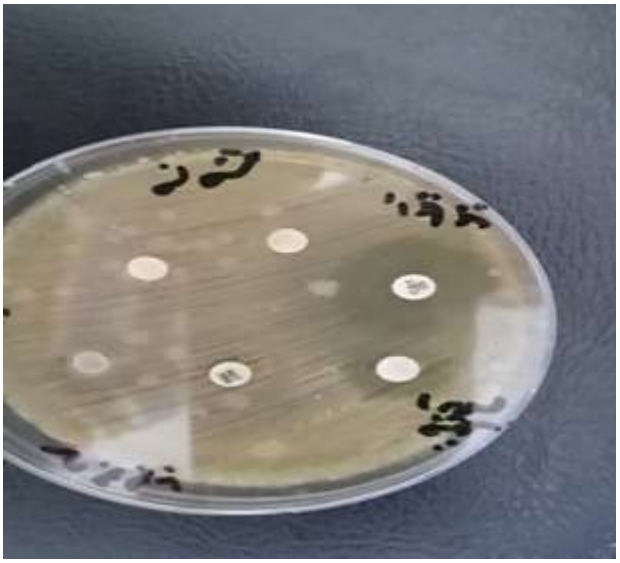
As a percentage, we can say that jojoba oil inhibited Escherichia bacteria by 82.6%, as shown in the figure.
Results of Staphylococcus aureus allergy:
The diameters of the non-growth circles were as follows:
- Trimetoprim with sulfametoxazole 23 mm
- For jojoba 7mm
- For wheat germ 15mm



- As a percentage, we can say that wheat germ oil inhibited Staphylococcus aureus by 65.2% and by 30.34% for jojoba oil, as in the figure.

CONCLUSIONS

We observed the excellent effectiveness of jojoba oil against Escherichia coli bacteria isolated from a urine sample from a patient suffering from a urinary tract infection.
It can be confirmed that this strain can be resistant to some traditional antibiotics such as penicillins and cephalosporins.
If we compare the effectiveness of jojoba oil against this strain of bacteria with the effectiveness of amikacin, which is an antibiotic from the group of aminoglycosides.
We note that jojoba oil has an effectiveness of 82.6%.
This antibiotic, what confirms to us the resistance of the Escherichia coli strain on which we conducted the test to antibiotics, is the absence of any effectiveness of wheat germ oil against it.
On the other hand, we noticed an excellent effectiveness of wheat germ oil, reaching 65.2% of the effectiveness of trimethoprim with sulfamethoxazole, which is an antibiotic used in the treatment of many infections, such as acute otitis media in children and acute complications of chronic bronchitis in adults.
It must be noted that jojoba oil gave an effectiveness that reached 30.34% of the effectiveness of the previous antibiotic (trimethoprim with sulfamethoxazole).

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