



# Orega-NOT: DNA Barcodes of Oregano Collected from Different Distributors Across New York City

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## Abstract

Over the last several years, the spice and herb industry has been accused of replacing its products with cheaper or more readily available substitutes. Oregano has been said to be replaced with olive, sumac, and hazelnut leaves in stores, leaving consumers without the true herb they need for their dish and leading to potentially dangerous health risks. This investigation aimed to examine whether oregano distributors were being truthful with their labeling and distribution of oregano products, or whether they were scamming consumers. Samples of oregano DNA was amplified and sequenced, and the results were compared to the actual oregano plant (*Origanum vulgare*). Based on the highest bit score on BLAST, the results indicate that most samples included extraneous materials, most notably *Conradina canescens*, or false rosemary. Only one sample matched the *Origanum vulgare*, suggesting that many distributors substitute cheaper alternatives for oregano.

## Introduction

Over the last three decades, consumer demand for herbs has skyrocketed, making it a billion-dollar industry.<sup>1</sup> With the recent growth of the herb market, it is possible that corporations are willing to sacrifice honesty and integrity to make higher profits by substituting herbs with cheaper alternatives.

Mediterranean oregano (*Origanum vulgare*) has been used in cooking for thousands of years. Oregano spread throughout Europe for its unique taste and its ease to grow. Many Europeans believed that oregano had medicinal qualities, including as an analgesic and antipyretic. Oregano did not become widely used in the United States until after the Second World War. Today, oregano is used in a wide variety of foods, notably in Italian cuisine.<sup>2</sup>

In the last few years, several consumer protection organizations have raised concerns that oregano distributors may be employing unethical practices by purposely substituting oregano with cheaper alternatives, including olive, sumac, and hazelnut leaves.<sup>3</sup> Previous studies have applied various methodology including random amplified polymorphic DNA (RAPD) and sequence-characterized amplified region (SCAR) to determine the authenticity of oregano. These studies have found that nearly all samples tested (90.5%) contained foreign plant material that was not *Origanum vulgare*, with 59% having more than 20% extraneous material.<sup>4,5</sup>

Considering the most recent studies on oregano authenticity were done over five years ago, this project aims to determine whether oregano distributors have become more honest in their business practices or whether they still deceive consumers by using filler plants instead of oregano. Based on previous studies, we hypothesize that most of the samples will contain plant material that is not oregano, but some cheaper substitute. This study aims to use polymerase chain reaction to amplify the DNA of oregano samples and sequence the DNA to determine whether commercially available oregano is authentic or not.

## Materials and Methods



**Samples** Three separate oregano samples were taken from five different oregano distributors in stores across Brooklyn, New York, allowing for a comprehensive review of the legitimacy of oregano labeling. The samples were all whole dried oregano leaves to ensure consistency among different distributors and more reliable DNA extraction.



**DNA Extraction and PCR** To extract the DNA from the samples, a half of a teaspoon of oregano was ground in a small tube with 300µl of lysis solution. The tubes were supposed to be incubated for 10 minutes at 65°C, but due to errors in regulating the temperature of the water bath, the tubes were instead incubated for 12 minutes at 60°C. A silica resin was added, and the samples were then purified through a process of centrifuging and adding wash buffer. The DNA was amplified through PCR to allow for sequencing. The samples were then run through a gel electrophoresis to determine which samples were properly processed and viable for sequencing.



**DNA Subway and Analysis** The DNA was sequenced and analyzed on DNA Subway. After trimming the sequences and running the pair builder and the consensus editor, a BLAST was performed on all the samples. Using the Bit Score, the database found the most likely candidate for what species each sample belonged to. By matching the highest bit score to a particular match, the group was able to determine what each sample consisted of.



Fig. 1: Image of gel electrophoresis

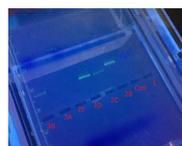


Fig. 2: Image of second gel electrophoresis

## Results

The data supports our hypothesis that most oregano distributors include foreign plant material in their product. Only 1 of the 10 samples showed that it included authentic oregano.

Sample Number	Bit Score	e	Mismatches	Species Name
KHD-001-3A	1016	0.0	15	<b>Symphytotrichum eatonii</b>
KHD-004-1B	1085	0.0	3	<b>Conradina canescens</b>
<b>KHD-004-2B</b>	<b>1077</b>	<b>0.0</b>	<b>1</b>	<b>Origanum vulgare</b>
KHD-004-3B	1083	0.0	2	<b>Conradina canescens</b>
KHD-002-1C	1085	0.0	3	<b>Conradina canescens</b>
KHD-002-2C	1083	0.0	2	<b>Conradina canescens</b>
KHD-002-3C	1085	0.0	3	<b>Conradina canescens</b>
KHD-003-1D	1085	0.0	3	<b>Conradina canescens</b>
KHD-003-2D	1081	0.0	3	<b>Conradina canescens</b>
KHD-003-3D	1081	0.0	4	<b>Conradina canescens</b>

Table 1: Identification of sequenced samples.



Fig. 3: *Symphytotrichum eatonii*, commonly known as Eaton's aster. This plant was found in sample 3A.



Fig. 4: *Origanum vulgare*, commonly known as oregano. This plant was found in sample 2B.



Fig. 5: *Conradina canescens*, commonly known as fake rosemary. This plant was found in samples 1B, 3B, 1C, 2C, 3C, 1D, 2D, and 3D.

## Discussion

- Only one sample, Sample B, showed that it contained *Origanum vulgare*. The other samples contained either *Symphytotrichum eatonii* or *Conradina canescens* which are known substitutes for oregano.
- These results coincide with previous studies done on Mediterranean oregano. The data shows that 90% of the samples tested did not contain oregano, which qualifies the RAPD and SCAR data from previous studies.<sup>4</sup>
- Labeling the product as oregano when it contains other plants is deceitful and dishonest. Consumers put their trust in corporations to be truthful when labeling their products, and purposeful mislabeling violates that trust.
- Another concern could be health impacts, notably for people who suffer from allergies. While one may not have any immunological response to oregano itself, their body might identify *Symphytotrichum eatonii* or *Conradina canescens* as potential allergens, causing an allergic response.
- It is possible that errors in the experimental procedure contributed to data inaccuracies in the experiment. The methods for the extraction and amplification of DNA were quite intricate and time-consuming, so it is possible that some contamination occurred while processing the samples.
- While eight out of ten samples testing as *Conradina canescens* may indicate widespread fraud in the oregano market, it could also point to an error in the experimental procedure. Testing more samples from each distributor or sampling oregano from other oregano distributors could validate the data and provide more insight into possible fraud.
- Future research can use more advanced techniques to analyze the genetic material of oregano from different distributors; such techniques include isotopic analysis, enzyme-linked immunosorbent assay and spectroscopy. Additionally, research can look into other herbs, such as rosemary and thyme, which may also be inaccurately labeled.

## References

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