

## Abstract

- A vegan diet consists of vegetables, grains, nuts, fruits, and plant-based foods, and excludes any animal or dairy products (“The basics of A vegan diet,” n.d.). Vegan and vegetarian diets have been associated with environmental protection, animal rights, and health. However, adopting a vegan diet can be expensive.
- Samples of vegan-advertised products from different fast-food restaurants were tested for animal DNA with the goal of investigating whether they are vegan.
- The hypothesis for the project is that there would be animal DNA in vegan options offered at fast-food chains.
- This is important for consumer safety and restaurants' credibility of the vegan options that they are selling. In all the samples from fast-food chains, no invertebrate, vertebrate fish, or vertebrate non-fish DNA was found through PCR amplification or sequencing.
- We can conclude that the vegan/vegetarian options offered by fast-food chains are low-cost options for consumers with dietary restrictions.

## Introduction

- The number of Americans with vegetarian and vegan dietary restrictions has slowly increased over time. Reasons for the dietary shift may include:
  - Eating red meat and processed meats being associated with an increased risk of death from heart disease, stroke, or diabetes (Mayo Foundation for Medical Education and Research, 2020)
  - Rare allergic reactions to animal products
  - Moral opposition to animal treatment in factory farms
  - Excessive use of antibiotics in animals may lead to the development of a ‘superbug’ bacteria (Plumer, 2013)
  - Environmental factors since raising animals for human consumption leads to environmental destruction (Dopelt et al., 2019)
- However, it may be more difficult for people in low income communities to make the choice to switch to a vegetarian and vegan diet since it can be expensive. Food swamps—“a high density of establishments selling high-calorie fast food and junk food”—have taken over low-income communities and are a strong predictor of high obesity rates in the U.S. (Cooksey-Stowers et al., 2017). For people in low-income communities, low-cost unhealthy meals are more affordable and accessible than more expensive but healthier counterparts, especially when they have many family members to feed.
- Recently, some fast-food chains have begun to provide plant-based options to consumers. So, even if someone lives in a “food swamp,” they may now have easier access to affordable plant-based meals at fast-food restaurants.
- The goal of this project was to find out if fast-food chains can provide consumers with authentic vegan and vegetarian food options, and therefore make these foods available to consumers at a lower cost.

## Materials & Methods

- Food samples that are advertised as vegan were collected from their respective restaurants:
  - Burger King: Impossible Whopper
  - Chipotle: Sofritas
  - White Castle Veggie Slider
  - White Castle Impossible Slider
- For the Sliders and the Whopper, only the patty of the burgers was tested because they are advertised as the primary vegan and vegetarian products.
- A sample of 5 mg of each food item was isolated.
- Utilizing the East Harlem DNA Learning Center lab, the Silica DNA Isolation Kit was used to separate the food samples' DNA from other cell parts. PCR was done to amplify the DNA for sequencing according to the protocol provided by CSHL DNA Learning Center using plant and animal primers. PCR was also conducted on control vertebrates, invertebrates, and plant DNA provided by the DNA Learning Center. Plant and/or animal DNA presence in the food samples was confirmed through Gel Electrophoresis; the positive samples were sent to Genewiz for Sanger sequencing. The DNA sequences were analyzed by DNA Subway.

## Acknowledgements

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## Results & Discussion

**Table 1. Explanation of Fast-Food Sample and PCR Primers used in Experimental Sample**

Primers used in PCR	Fast-Food Sample						
	Control Chicken	Impossible Slider from White Castle	Veggie Slider from White Castle	Impossible Whopper from Burger King	Sofritas from Chipotle	Water	Control
Vert Fish	Sample 1*	Sample 9*	Sample 17	Sample 25	Sample 33	Sample 41	Sample 45
Vert Fish	Sample 2*	Sample 10*	Sample 18	Sample 26	Sample 34	-	-
Vert Nonfish	Sample 3*	Sample 11	Sample 19	Sample 27	Sample 35	Sample 42	Sample 46
Vert Nonfish	Sample 4*	Sample 12	Sample 20*	Sample 28	Sample 36	-	-
Invert	Sample 5	Sample 13	Sample 21	Sample 29	Sample 37	Sample 43	Sample 47
Invert	Sample 6	Sample 14	Sample 22	Sample 30	Sample 38	-	-
Plant	Sample 7	Sample 15*	Sample 23*	Sample 31*	Sample 39	Sample 44	Sample 48
Plant	Sample 8	Sample 16*	Sample 24*	Sample 32*	Sample 40	-	-

\*Samples had a possible positive PCR results and were sequenced.

**Table 2. Gel A - DNA samples amplified using Vertebrate Fish primers**

100bp Ladder	Sample 1	Sample 2	Sample 3	Sample 4	Sample 9	Sample 10	100bp Ladder
100bp Ladder	Sample 11	Sample 12	Sample 17	Sample 18	Sample 19	Sample 20	100bp Ladder

**Table 3. Gel B - DNA samples amplified using Vertebrate Non-Fish primers**

100bp Ladder	Sample 25	Sample 26	Sample 27	Sample 28	Sample 33	Sample 34	100bp Ladder
100bp Ladder	Sample 35	Sample 36	Sample 41	Sample 42	Sample 45	Sample 46	100bp Ladder

**Table 4. Gel C - DNA samples amplified using Plant primers**

100bp Ladder	Sample 7	Sample 8	Sample 15	Sample 16	Sample 23	Sample 24	100bp Ladder
100bp Ladder	Sample 31	Sample 32	Sample 39	Sample 40	Sample 44	Sample 48	100bp Ladder

**Table 5. Gel D - DNA samples amplified using Invertebrate primers**

100bp Ladder	Sample 5	Sample 6	Sample 13	Sample 14	Sample 21	Sample 22	100bp Ladder
100bp Ladder	Sample 29	Sample 30	Sample 37	Sample 38	Sample 43	Sample 47	100bp Ladder

DNA sequences were analyzed by DNA Subway. The results were:

Samples 1, 2, 3, and 4, which were the control chicken samples mapped to the reference genome for *Gallus gallus* (Red junglefowl), which is a variation of chicken.

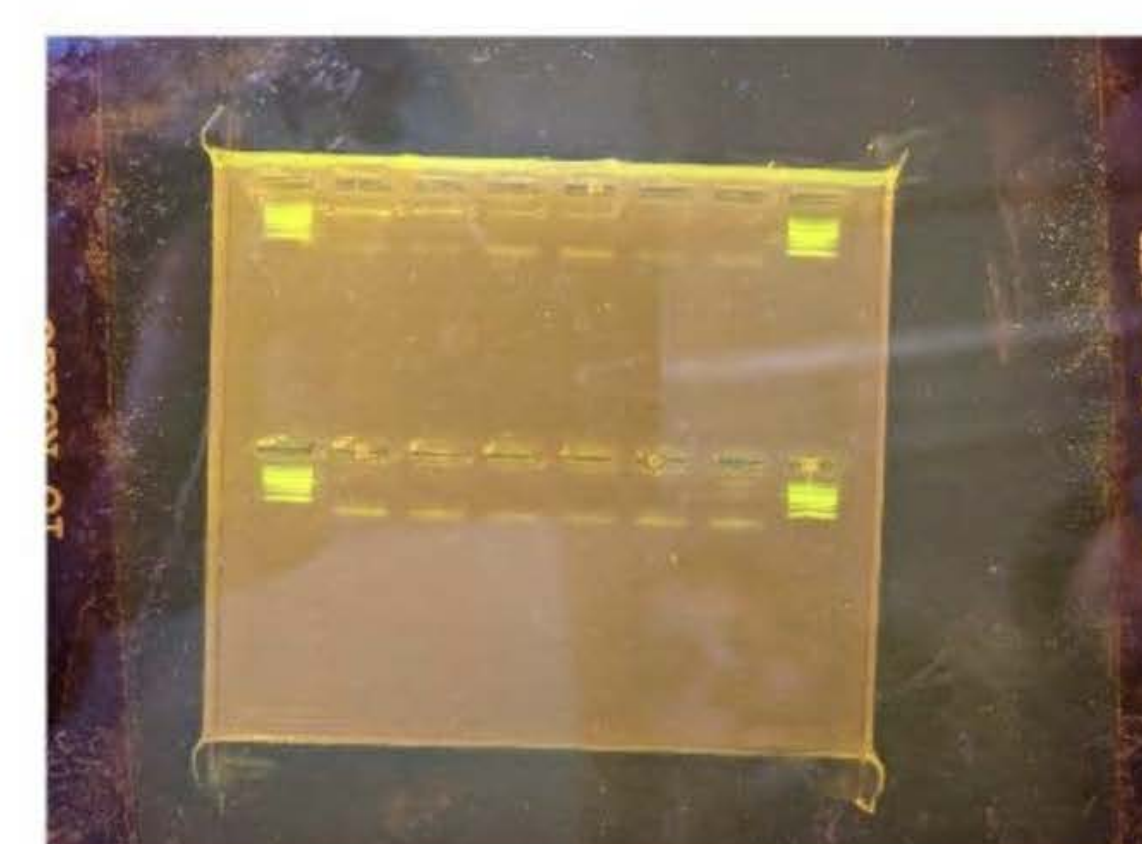
Sample 20, 23 and 24, which were the White Castle veggie slider samples, mapped to reference genome for *Daucus carota* (Wild carrot), *Ligusticum scoticum* (Cots Lovage), *Torilis japonica* (Japanese hedge parsley), *Scandix stellata* (Scandix), *Anthriscus caucalis* (Burr chervi), *Osmorhiza depauperata* (Bluntseed sweetroot), *Pternopetalum delavayi* (Franch), *Yabea microcarpa* (Dicot).

Sample 31 and 32, which were the Burger King Impossible whopper sample, mapped to reference genome for *Sinapis alba* (White mustard), *Coincya wrightii* (Lundy cabbage), *Sinapis arvensis* (Charlock mustard), *Brassica nigra* (Black mustard), *Brassica tournefortii* (Asain mustard), *Coincya monensis* (Dicot), *Crambe strigosa* (Crambe), *Diptotaxis catholica* (Wall rocket), *Hirschfeldia incana* (Shortpod mustard), *Cakile edentula* (American searocket), *Savignya parviflora* (Savignya), *Rapistrum rugosum* (Turnipweed), *Narcissus poeticus* (Poet's narcissus), *Horwoodia dicksoniae* (Khozama), and *Aurinia saxatilis* (Basket of gold).

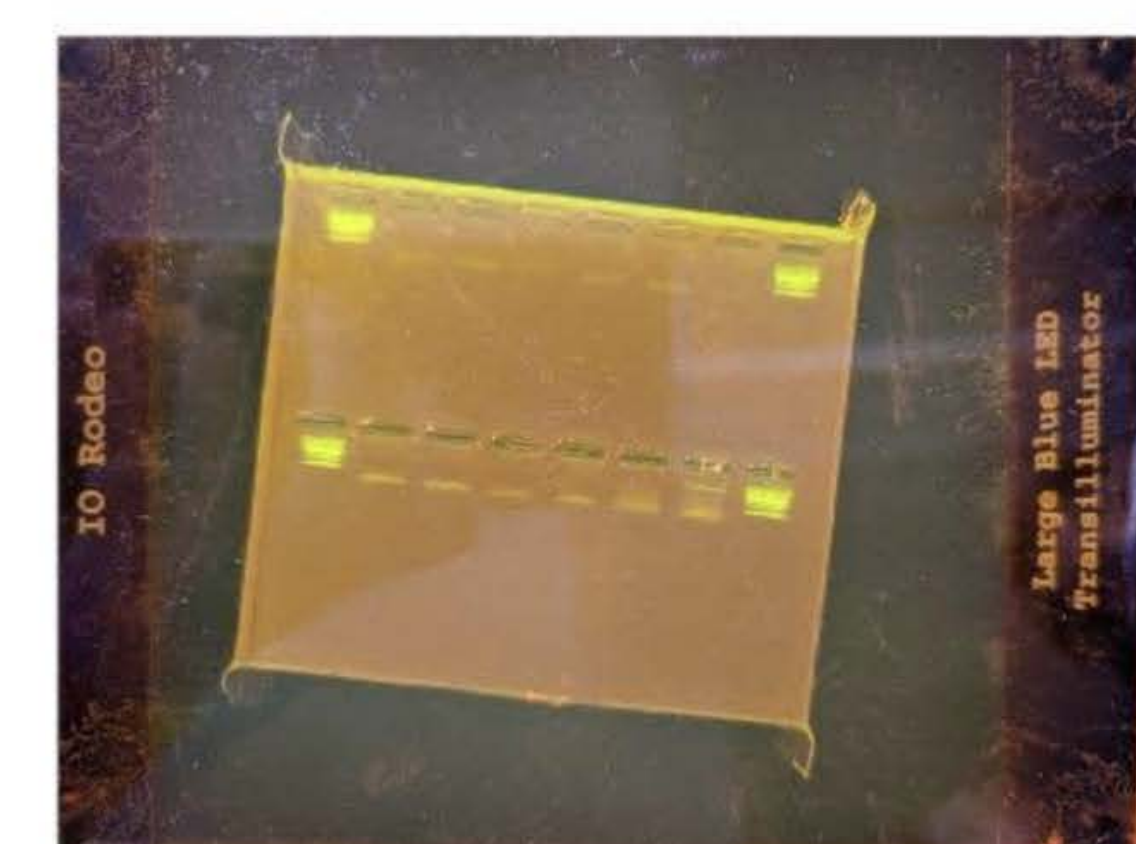
PCR samples were analyzed using gel electrophoresis. Positive PCR results were that the control chicken food sample was amplified using vertebrate primers and the plant PCR primers amplified the samples for the Impossible slider, Impossible Whopper, and veggie slider.

PCR and sequencing results showed that there was animal DNA (fish vertebrate, non-fish vertebrate, or invertebrate) present in any of the vegan options DNA samples. As a result, this study finds that there are no non-vegan components in these fast-food options and that the vegan options offered by fast-food chains are a safe low-cost option for consumers with dietary restrictions. Vegan and vegetarian options offered by Burger King, White Castle, and Chipotle are safe to consume and people with dietary restrictions should not have any problems when consuming these vegan/vegetarian options offered by these fast-food chains. Initially, a goal of this study was to study more samples from a variety of fast-food chains, but these samples were not possible to obtain because they were unavailable at the fast-food chains that were investigated. This may indicate a large issue in the accessibility of vegan foods, rather than their food safety. In future studies, these findings could be expanded by testing more fast-food chains from different areas of New York. Another option for future research could be to test the different components of what is offered in a vegan/vegetarian option, such as the bun of a slider, rather than just testing the vegan-meat portion.

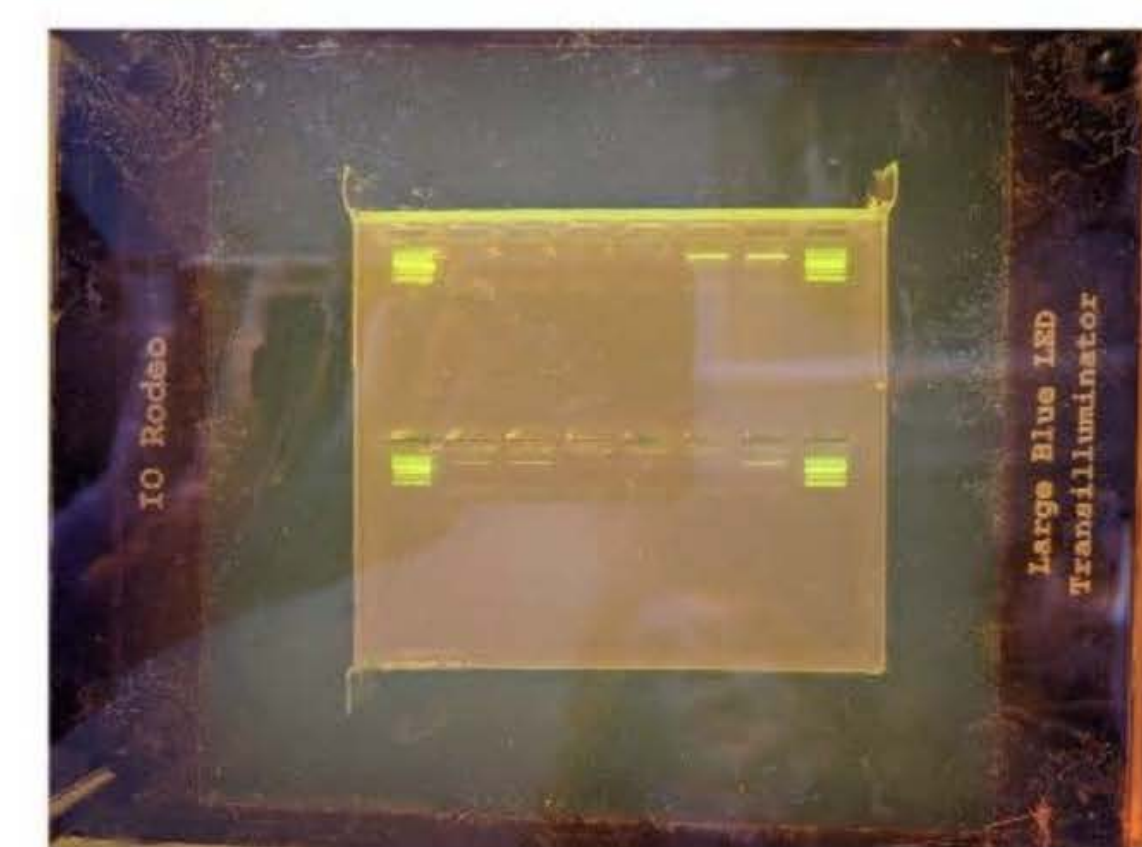
**Figure 1. Images of gels to view PCR products. Explanation of samples in each gel shown in Table 2-5**



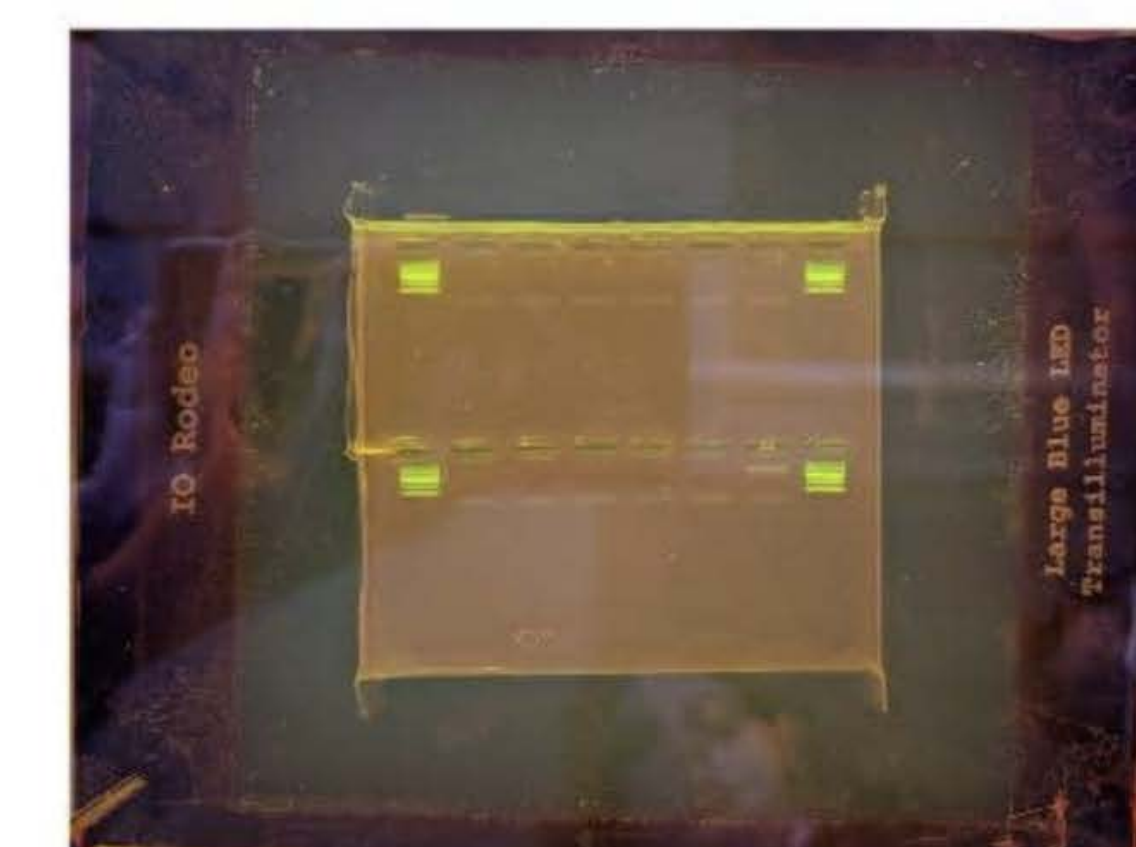
Gel A: Vertebrate Fish Primers



Gel B: Vertebrate Non-Fish Primers



Gel C: Plant Primers



Gel D: Invertebrate Primers

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