

By: Maxwell Arko

Advisors: Dr. Christopher Thoms and Dr. Jean Lavigne

### Introduction

In the U.S. food is primarily produced with the use of industrial farming methods that rely on technological advancements, chemical pesticides and fertilizers, and generally unsustainable practices. Our reliance on the current food system contributes to climate change, carbon emissions, public health crises, and a lapse in ethical standards for the treatment of livestock. Conventional meat production reinforces these negative impacts and an alternative system is desperately needed. Although alternative protein sources are readily available at most grocery stores, consumers still face the difficult decision of finding an adequate protein source that meets the specific needs of each consumer. To aid the consumer in the search for an alternative protein source I created a consumer's guide, which ranks each alternative protein source in a variety of categories, based off of consumer motivations. To create this guide, I examine alternatives to conventional protein production, specifically comparing aquaculture, organic meats, and vegetarian diets as the most common and economically feasible alternatives. Using an extensive literature review to establish standards for consumer needs and a comparative analysis of individual products, I explore these alternatives and compare their environmental, nutritional and ethical standards to those of conventional meat production.

### Non-Meat Alternatives

Non-meat alternatives (100 calorie portion)	Protein (g)	Total fat (g)	\$/lb.
Green Beans	7	0	3.09
Broccoli	9	0	2.42
Green Kale	6	0	3.31
Green Lentil	9	0	2.38
Pinto beans	7	1	2.87
Black Beans	7	1	2.85
Tofu (soft)	10	5	2.82
Eggs	9	6	2.40 (dozen)

Listed are the non-meat alternatives that were used for in this project. Nutritional facts are based off of a 100 calorie portion. Serving size varies for each product.

### Consumer Guide

	Sustainability	Health/Nutrition	Ethics/Animal Welfare
<b>Conventional Meat</b> • Beef, Pork, and Poultry • Driven by efficiency	<b>Poor</b> • High waste production • Heavy use of chemical products • High demand for resources • High emissions	<b>Fair</b> • Increased risk of high blood pressure, heart disease and some cancers • High in fats • Exposure to foodborne illness such as <i>E. coli</i> • Moderate protein content	<b>Poor</b> • Intensive rearing methods (CAFO) • No ability to behave naturally • Unreliable methods of slaughter • Poor quality of life
<b>Organic Meat</b> • Beef, Pork, and Poultry • Follows organic standards	<b>Fair</b> • No use of chemical pesticides, fertilizers, antibiotics or growth hormones in rearing or feed production • Managed in order to conserve resources and biodiversity • High demand for resources • High emissions	<b>Fair</b> • Increased risk of high blood pressure, heart disease and some cancers • High in fats • Exposure to foodborne illness such as <i>E. coli</i> • Moderate protein content	<b>Good</b> • Ethical standards are incorporated into USDA organic certification • Year-round access to outdoors • Raised in a way that supports natural behavior (space for exercise, clean/dry bedding, fresh air)
<b>Aquaculture</b> • Salmon • Closed system (Inland)	<b>Good</b> • Closed systems eliminate risks of introducing invasive species, spreading disease to wild populations and cross breeding between wild and farm-raised fish. • Filtration systems recycle large portion of waste • High demand for electricity	<b>Good</b> • High protein content • Good source of essential amino acids, which are shown to reduce the risk of stroke and heart attacks • Lower levels of mercury contamination	<b>Good</b> • Schooling fish such as salmon are naturally found in dense schools, making salmon an ideal fish to farm-raise • Fish indeed feel pain, which aligns with many ethical standards against inflicting pain in order to consume animal flesh
<b>Non-Meat Sources</b> • Vegetables, fruits, beans, tofu, etc. • Conventional and organic options	<b>Excellent</b> • Most sustainable alternative • Conventional agriculture relies heavily fossil fuels (production and transportation) • Organic produce follows same organic standards as livestock • Moderately resource demand	<b>Excellent</b> • reduced risk of heart disease, obesity, diabetes and some cancers • Consumers must be aware of protein-rich sources to maintain daily protein needs • Moderate-high protein content • Low in fats and calories	<b>Excellent</b> • Without the need to inflict pain or kill other living species, most ethical standards hold non-meat diets as the most ethical protein source

This consumer guide is intended to help consumers switch away from conventional meat and towards alternative protein source. The table lists the four protein sources under review and compares them across three consumer needs/motivations. To use this guide, simply select a protein source and continue across the table to review the environmental impact, nutritional and health effects and ethical considerations of consuming the product. If one cares to review protein sources against a particular motivation, simply chose a consumer motivation and continue down the table for each protein source's ranking. The comparisons within this guide compare the four protein sources and ranks them compared to conventional meat production.

### Methods

In order to effectively compare the alternative protein sources, I used an extensive literature review to set the standards for consumers needs and to better understand the effects of conventional and alternative protein production. I used primary data from a variety of sources, including The U.S. Department of Agriculture (USDA) and U.S. Department of Labor's Bureau of Labor Statistic (BLS), to establish meat consumption patterns, trends in alternative protein production and consumption, and economic standards for retail pricing of each product investigated. Additionally, I gathered current retail prices, product availability, and product variety from multiple local grocery stores such as Lunds and Byerlys, Coborns and Good Earth Food Co-op. In order to determine how each alternative compares to conventional meat production, I compared the protein sources in a variety of fields. I analyzed the environmental impacts, nutritional value, health risks and benefits, and ethical dilemmas of each alternative in order to rank each product in comparison to conventional meat products.

### Meat Alternatives

Meat Alternatives	Protein (g)	Total Fat (g)	\$/lb.
Ground Beef (85/15)	8	7	5.54
Organic G.B.	9	7	9.44
NY Strip	7	10	13.65
Organic NY Strip	9	11	13.31
Top Sirloin	11	6	9.32
Organic Top Sirloin	11	6	11.99
Chicken Breast (Skinless/Boneless)	21	1	7.30
Organic C.B. (Skinless/Boneless)	22	1	8.99
Wild-Caught Organic Salmon	14	5	16.99
Farm-Raised Salmon	14	5	9.99

Listed are the animal protein sources that were used for in this project. Nutritional facts are based off of a 100 calorie portion.



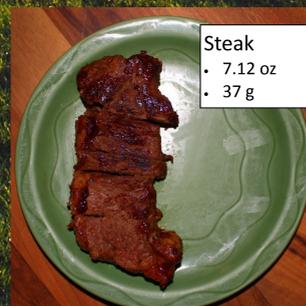
**Vegetables**  
• 36 oz.  
• 20 g



**Beans**  
• 33 oz  
• 86 g



**Tofu**  
• 32 oz  
• 53.3 g



**Steak**  
• 7.12 oz  
• 37 g



**Salmon**  
• 9.6 oz  
• 71.86 g



**Chicken**  
• 11.7 oz  
• 73.12 g

### More Bang for your Buck

The average American spends almost \$6.00 each day fulfilling their protein needs. The pictures on the left demonstrate the amount of each protein source that a consumer is able to purchase based off of the average daily expenditure on protein needs. Additionally, each photo says the amount of food (ounces) and the amount of protein (grams). This demonstration shows how a consumer can purchase more quantity of produce and non-meat protein sources while also meeting their daily protein needs.