

## Introduction

Nutraceuticals are an alternative to modern medicine that combine nutritional and pharmaceutical properties to maximize human health and wellbeing. "Nutraceuticals can be defined as 'a food that provides medical or health benefits, including the prevention and or treatment of a disease.'" [4]. Nutraceuticals include whole foods, food additives, herbs, phytonutrients, probiotics, vitamins, minerals, and herbal products. The theory is that increased use of nutraceuticals in consumers diets will reduce the need for prescription medicine.

This poster serves as an exploration of the process of manufacturing nutraceuticals and their environmental impact. The poster also provides a potential research protocol for the prevention of diseases for nutraceuticals.

## Process Description

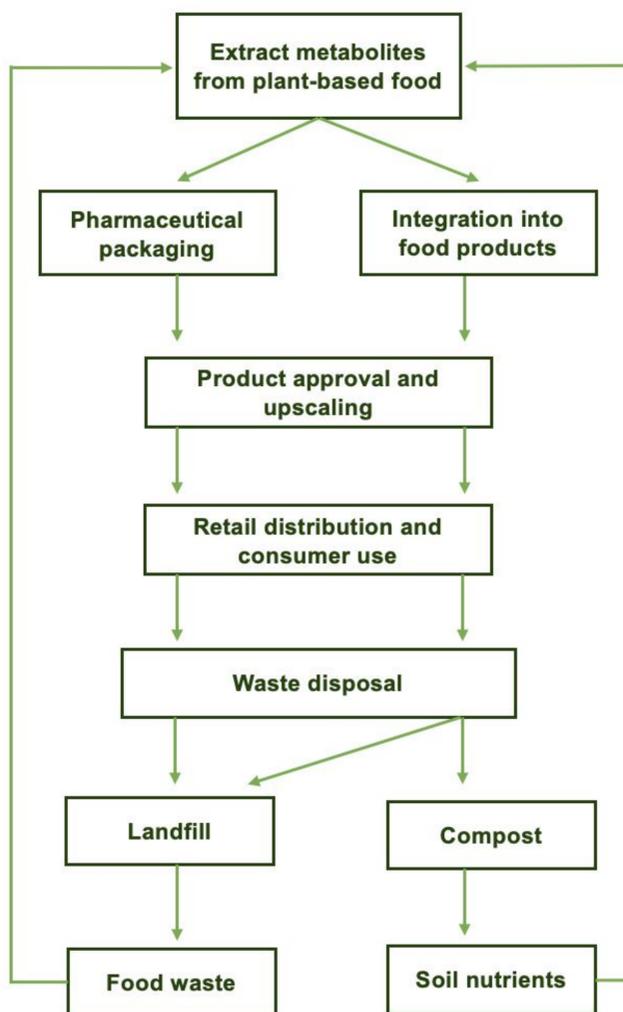


Figure 1. Product life cycle of nutraceuticals [6]

## Potential Impact on Ecosystem Services

### Food Waste

The Food and Agriculture Organization of the United Nations estimates, as of 2017, that one third of food produced for human consumption is lost or wasted, this comes to approximately 1.3 billion tons of food [5]. Food loss is defined as food quantity decreased by supply chain actors while food waste occurs at the consumer or retail level [5]. Reducing food loss and waste is important for the United Nations in meeting Sustainable Development Goals, including but not limited to ending hunger and ensuring sustainable production practices [5].

### Nutraceutical Possibilities

Nutraceutical production is able to take advantage of agricultural and horticultural wastes that are rich in nutrients, as displayed in Figure 1 [6]. Often fruits and vegetables are 25-30% inedible seeds, skins, and cores, but these parts are actually full of phytochemicals that are helpful nutraceuticals when harvested from the wastes [6]. The coffee industry is large and produces many waste products as well. Products like silver skin, spent waste, and cherry husk all showed phenolic presence, and the bioactive conserves from the by-products showed high antioxidant activity [6]. Beyond agriculture, the dairy process by-product whey contains nutraceutical components like immunoglobulins, vitamins, and minerals [6]. Mango fruit peel and seed kernel also contain high levels of phytochemicals, but are currently regarded as waste products even though they consist of 15-20% of the fruit [6]. Apple juice is another process that generates food waste with apple pomace being 25-35% of the fruit wasted but contain high amounts of pectin that are great for gelling other products like nutraceuticals [6].

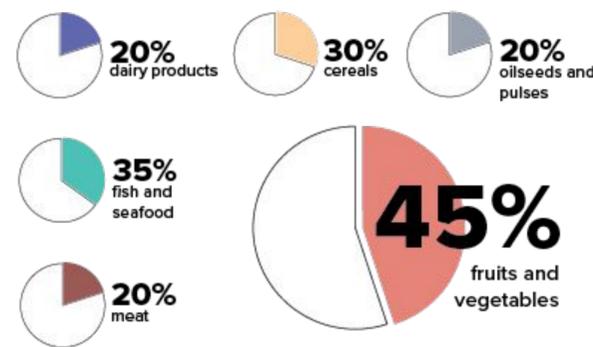


Figure 2. Percentage of produced food that goes to waste [7]

As referenced in Figure 2 [7], dairy products and fruits and vegetables are among the most wasted food groups and nutraceuticals are able to take particular advantage of these. This proves beneficial to the original producer, supply chain, and customer as it improves the economy of the product and reduces waste, making the whole process more environmentally responsible.

## Sensitive Unit

Nutraceuticals are known for causing many effects on human health, however, lack of control in its usage may cause some issues. Although the advantages of this product are more well known than the disadvantages. it is important to know both sides before consuming nutraceuticals

### Advantages

- Increasing life expectancy [10]
- Reducing risk of disease [10]
- Slowing the aging process [10]
- Influencing mood, athletic and intellectual performance [10]
- Supporting the structure or function of the body [1]
- Preventing chronic diseases such as cardiovascular diseases, cancer, allergies, Alzheimer's, diabetes, inflammations, Parkinson's, etc. [1]
- Improving the immune system [1]
- Relieving anxiety [1]
- Improving overall health [1]
- Boosting energy [1]
- Improving mental clarity [1]
- Enhancing sleep quantity and quality [1]

### Disadvantages

- Demand and lack of control could create a marketplace full of doubtful and exaggerated claims [10]
- Creates a replacement for prescription medications and lack of trust in the healthcare system [11]
- Shown to have side effects when interacted with other drugs [11]
  - The Department of Veterans Affairs dedicated a section on their website including possible interactions between food and drugs [11]

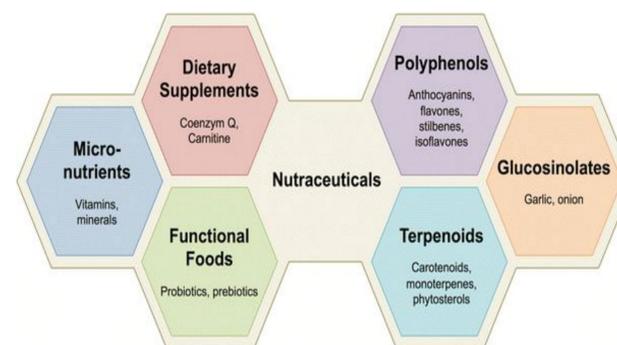


Figure 3. Classifications of nutraceuticals [13]

## Research

One of the main areas of potential research in use of nutraceuticals is determining how nutraceuticals prevent certain diseases and chronic illnesses such as cancer and cardiovascular diseases.

In a 2018 study, researchers found that nutraceuticals could be used with statin intolerant patients by helping to control low-grade systemic inflammation and lipid abnormalities, causing an overall decrease in cholesterol and risk of cardiovascular disease [8].

In a 2019 study, it was found that "nutraceuticals can target multi-steps of tumor development," due to their diverse chemical structures [9].

With more research in these areas, nutraceuticals could become a widespread way to prevent cancer and cure diseases such as cardiovascular disease.

Nutraceuticals are a natural supplement, as seen in Figure 4, and have a plethora of health benefits on their own.



Figure 4. An artistic rendition of a nutraceutical, emphasizing its natural properties [12].

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