Edible Food Packaging

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At first thought of the concept, edible packaging might incite interesting reactions and questions like: "Isn't the point of packaging to protect the food inside?" or "Won't it get dirty?" In fact, it is probably even more difficult for people to understand eating the container that their food comes in as it is to eat insects. But if we take a moment to think, we as humans have consumed "edible" containers as long as our existence.

Let us look at the way that we treat our fruits and vegetables. We have been eating apples and kumquats with their skins since their cultivation. The skin of an apple is filled with vital nutrients from fiber and vitamins to powerful antioxidants such as quercetin, shown to fight off brain tissue damage in rats. The skins are even containers of antimicrobials against Gram-negative bacteria. As a species, we have not disregarded all peels that coat the produce we consume.

We even see edible containers in foods of our own creation. The ice cream cone, the tortilla, even the pizza, are all examples of edible containers that we have created to carry other foods within them. We can take great inspiration from both natural and artificial sources when we are creating new items that are traditionally made from petroleum-based plastics.

Now to the problem: surely a great many people already know how big of a problem plastic is for our environment and our surroundings. Plastic takes a millennium to break down regardless of where is it discarded, and is most often thrown into landfills. That means that all of the plastic that has ever been created is still around, somewhere, except for the miniscule amount that has been recycled. Only about 5% of all plastic is actually recycled, and every year enough plastic is discarded to circle the entire earth four times. Still worse, several additives are involved in the generation of plastic that have been shown to have toxic effects on hormonal balance. One of the most notorious, Bisphenol A (BPA), was found in the bodies of 93% of Americans ages six or older.

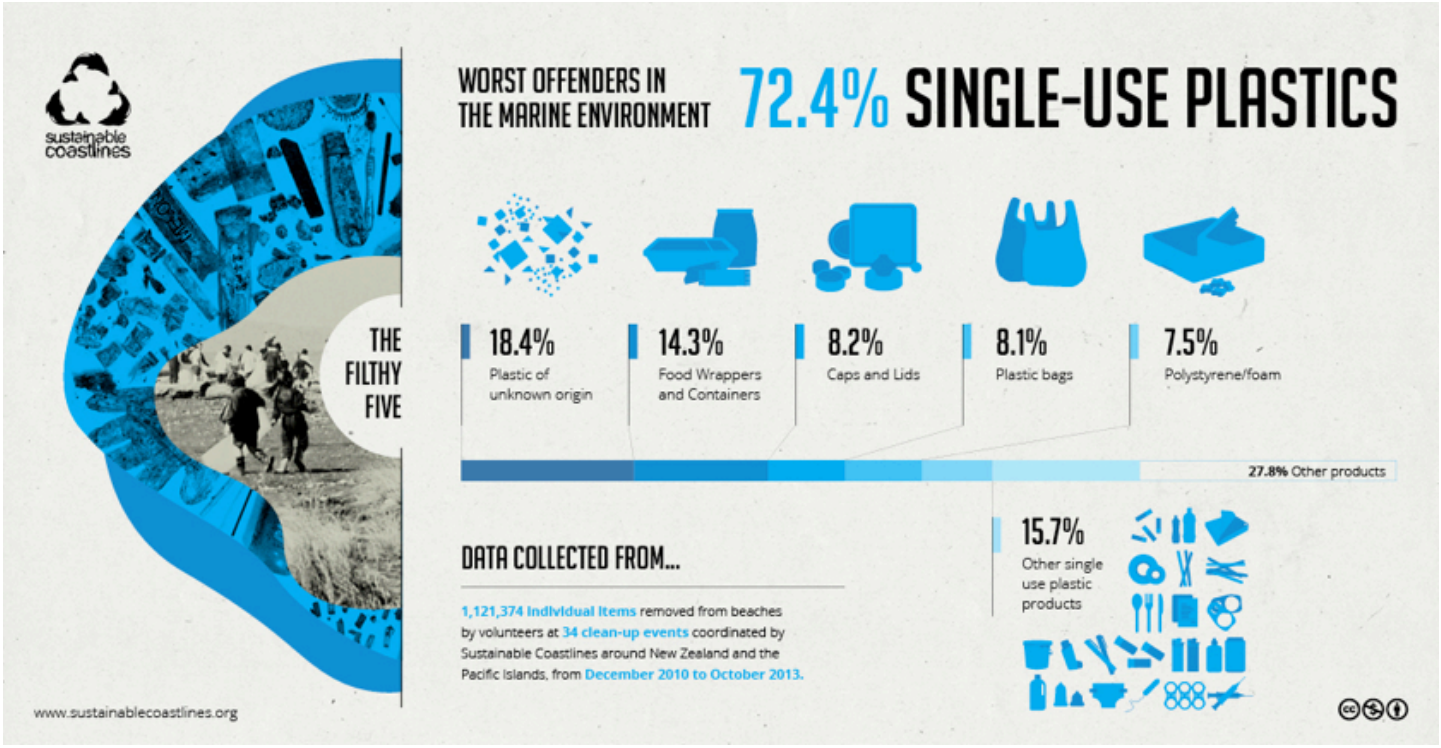
There are several approaches that aim to solve the plastic problem. This essay is going to focus on food-based packaging and plastic rather than all packaging and plastic as a larger concept. First and foremost, we can increase the percentage of recyclable materials that we use. Similarly, we can also increase the percentage of compostable

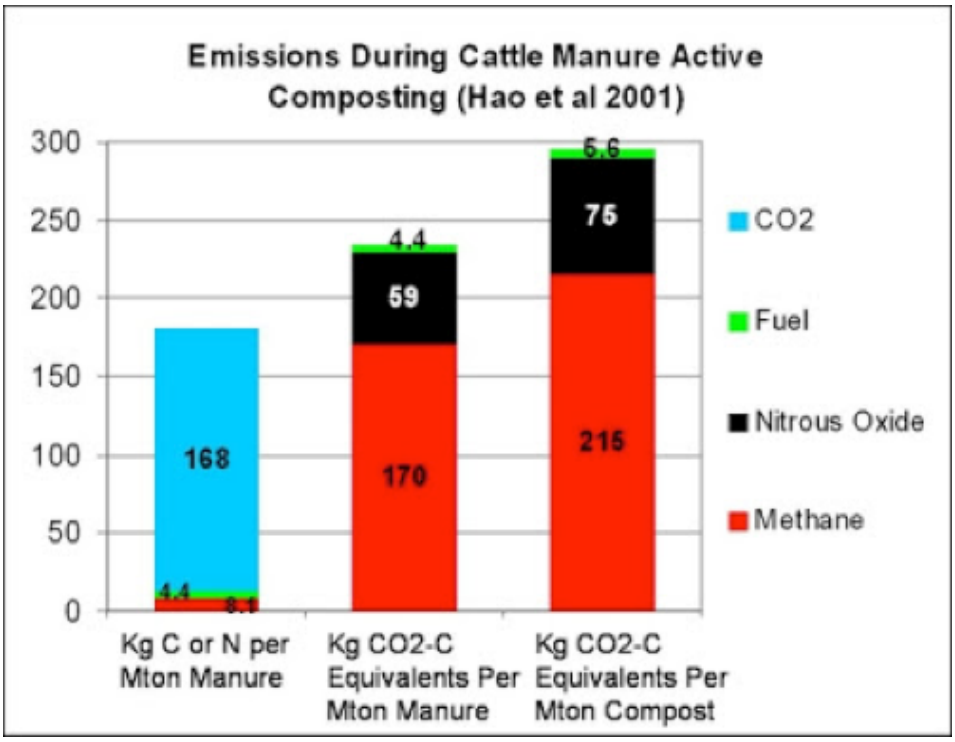
and/or biodegradable materials used in our packaging and containers. But there are potential issues with both of these solutions. Recycling has a high energetic cost in itself in terms of sorting and transportation, and many case studies have found that it costs significantly more than landfill disposal. For instance, a case study in Nova Scotia found that recycling programs there cost $18 million more per year than landfill disposal. Of course, there are energetic savings from recycling a material versus generating from virgin materials, but this is dependent on a case-by-case basis. If these programs are well maintained and there is very little recycling material going into a landfill, then these programs can eventually be effective. However, Austin Resource Recovery has found that even within Austin, 40% of materials that can be recycled are not properly disposed of, sending unnecessary waste to landfills. In these situations, recycling processes are actually significantly expensive and do not offset their cost with their benefits.

Another issue arises with compost, which is actually still a fantastic solution to the problem. Firstly, most bioplastics that are biodegradable and compostable are actually taken from feedstock, creating an ethical and moral dilemma (although this argument has its drawbacks, as even with our current food production, if none of it was wasted, there would be more than enough to feed everyone). Furthermore, compost still has a significant ecological footprint. Most current bioplastics are only compostable in industrial systems and must be collected and transported. For example, the carbon footprint of collecting, transporting, and distributing 5 tons of compost is roughly equal to the cost of growing, handling, and transporting 5 tons of bananas. Compost may be more effective on a smaller scale, but this is more difficult in urban areas where there is little space for each area to have its own smaller scale compost.

It can be inferred that the most eco-friendly method is to not generate any food related waste in the first place. Reusable containers are not an easy solution to implement in today's world, as can be seen by the relative inefficiencies of packaging free grocery stores. Furthermore, there are always end of life issues with reusables, as so many of them are already plastic based and not properly recycled.

That brings us to the most practical solution of all: if we were able to just not generate any food related trash in the first place (both food waste and food related packaging and disposable containers). Our research deals





with creating an edible polymer that can be thermoformed into plastic materials similar to those that currently exist. This includes a range of tableware as well as containers of foods such as sandwich bags and food wrappers and packaging. The polymer itself incorporates materials that are likely to go to waste. For instance, currently 40% of all produce is wasted and sent to landfills, leading to a significant carbon footprint. The goal is to incorporate this produce into the base material and create nutritious packaging as well as tableware. Another goal is to be able to incorporate industrial byproducts as the primary polymer within the material, thus such as whey and casein, which are industrial byproducts of dairy. This helps defer much of the ethical dilemma involved in bioplastic production. The material is processed at substantially lower temperatures than petro-based chemicals, and its actual production can have significantly lower energetic costs.

Edible packaging still has that gross factor to some, especially in those in Western countries. Thus, the goal is to start with creating edible tableware materials such as utensils, cups, plates, and bowls, with sleeves similar to ice cream cones in order to get the general public used to the concept. This material can reduce significant amounts of waste during outdoor events such as marathons or sports events where waste may often be challenging and expensive to clean up later. In this case, a reduction in waste can actually be more economical. As landfills become more packed and the cost of waste disposal rises, this also provides an opportunity for fast food restaurants to get involved with this kind of product.

There are currently other initiatives being taken to begin this movement surrounding edible packaging. For instance, LoliWare is a company creating edible agar based cups, while WikiCells is creating a shell that can hold foods and drinks created from food particles. Both of these have their drawbacks, as their primary ingredients are rarer and contribute to the expense of the end product, making scalability with the processes currently used more challenging.

Ultimately, the goal is to be able to create packaging that can encase single serve foods (not exclusively) in the future. Of course, there are challenges in creating this type of packaging as there are concerns with shelf life that must be addressed as well as protection against mold and bacteria. The material must be incorporated with various antimicrobial proteins so that it is still attractive as a food to those who will consume it but not to the bacteria that may surround it. If we are able to take inspiration from nature and create something that can significantly prevent and/or reduce the need for packaging food, we can create a significant benefit for the future.