



THE POTENTIAL OF PEELS AS SUSTAINABLE CONSUMER PRODUCTS

For most of us, the skin and peels of many fruits and vegetables are intended to be thrown away. However, did you know that you could consume most of them?

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EXECUTIVE SUMMARY

- Banana peel flour is emerging as a viable substitute for wholemeal flour for bread making.
- Fruit and vegetable peels are finding their way into the recipes of home chefs and food bloggers, and hold tremendous opportunities in the packaged food space as well.
- One of the main drivers for this emerging trend is the ongoing search for solutions to tackle food waste, bolstered by the need for improved nutrition in our daily diets.
- Consumers may not be comfortable eating certain peels in their raw form, but brands can offer more palatable formats, such as in pickles, condiments, and snacks.
- Apple and potato peels, as well as watermelon rind, have the potential to emerge as functional and exciting foods products.
- Peel-based products can be sold directly to the consumer or be used as simple boosts to teas, soups, smoothies, desserts, and a range of other dishes, akin to seasoning.



MORE TO PEELS THAN AP-PEELING FOOD

A close-up photograph of a lemon slice and several strips of lemon peel on a dark, textured surface. The lemon slice is in the upper left, showing its juicy segments and white pith. The peels are curled and scattered to the right. A large, bright yellow circular graphic is partially visible in the bottom right corner.

Earlier this year, a recipe posted by food blogger **'The Stingy Vegan'** made a few waves across the internet. The recipe in question was a vegan pulled pork sandwich that used **banana peels*** as its main ingredient. Not surprisingly, the reactions were somewhat polarizing, but it did spawn some interest in other ways of using different peels. Banana peels are, in fact, regularly consumed in parts of Brazil, Venezuela, and India.

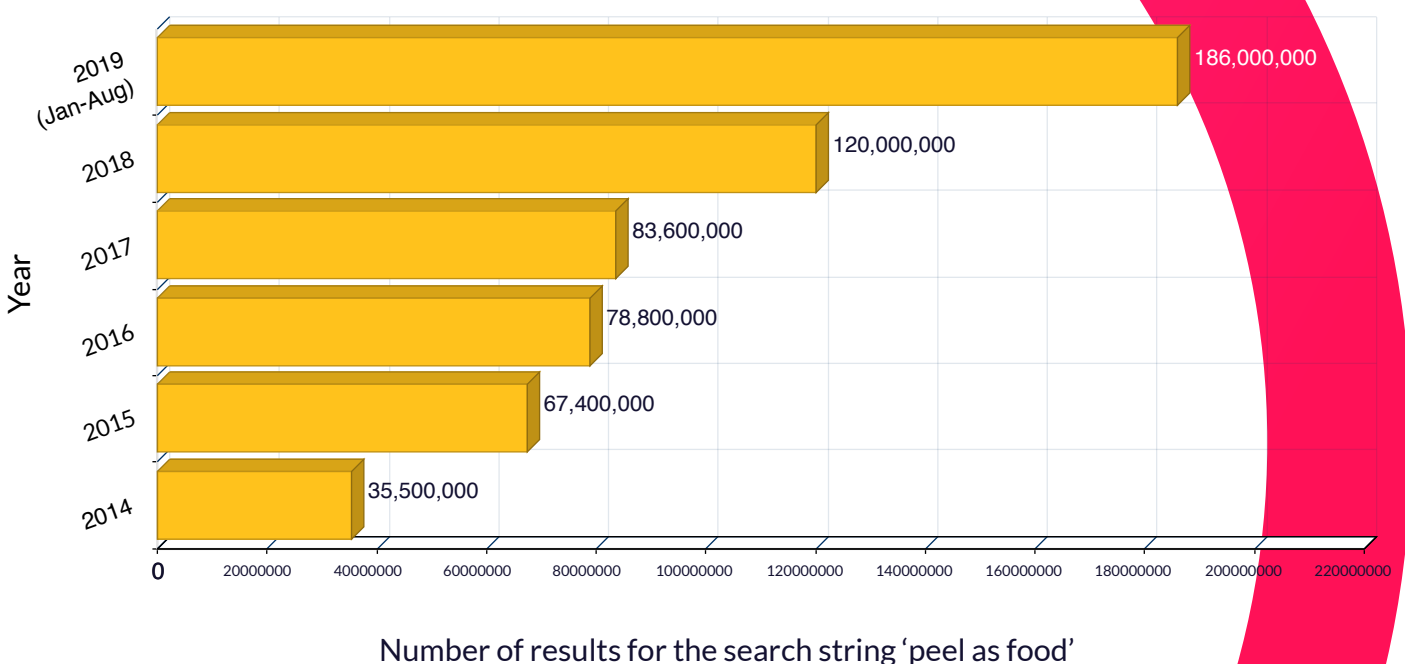
More often than not, fruit and vegetable peels end up in the garbage, but this recipe got us thinking about what other unusual peels are people consuming, and why. There are fruit and vegetable peels we eat without a second thought (such as those of tomatoes and guava). Many of us are familiar with the use of **orange** and **lemon zest** and accept them as popular ingredients in cooking and baking, while repurposing vegetable scraps to make stock is a common practice too. However, how many of us would readily chow down on watermelon rind or pumpkin skin?

* <https://www.buzzfeed.com/whitneyjefferson/banana-peel-bbq-vegan-recipe>

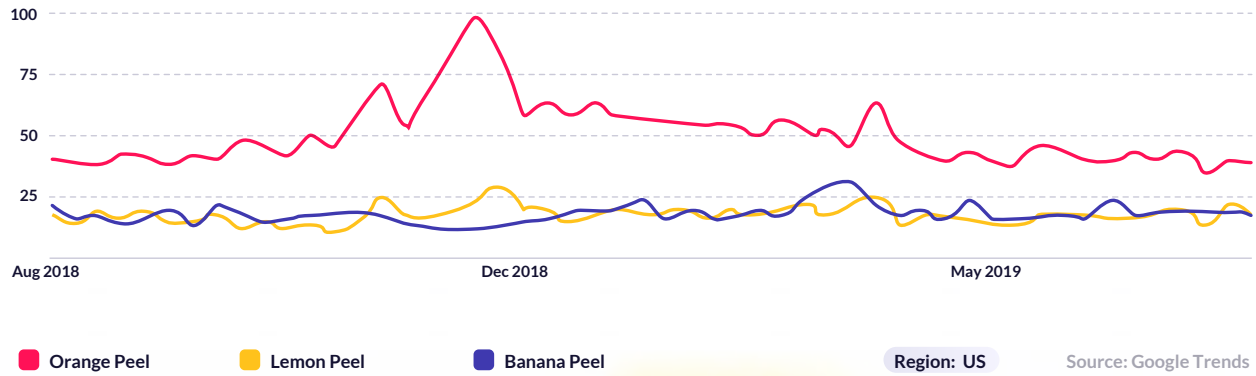
A quick Google search revealed a whole host of peels that are usually thrown away, including watermelon rind, potato skin, carrot, radish, and butternut squash peels, are now being repurposed into palatable foods. Home chefs are pickling, roasting, fermenting, drying, and frying these peels with a vengeance. They are especially making an appearance among people who are looking to use every part of their fruit and vegetables, for reasons that range from saving money (as The Stingy Vegan readily admits) to benefiting from the nutritional value.

Consuming a part of many fruits and vegetables that we usually throw away is still a pretty new phenomenon for many. However, this trend has the potential to hit the mainstream for several reasons. One of the most important factors is that of minimizing food waste, especially avoidable food waste, which is pushing up interest in zero-waste cooking tips, techniques, and food among sustainability-conscious consumers. In response, companies are also looking for ways to cut down their own waste and even potentially capitalize on peels.

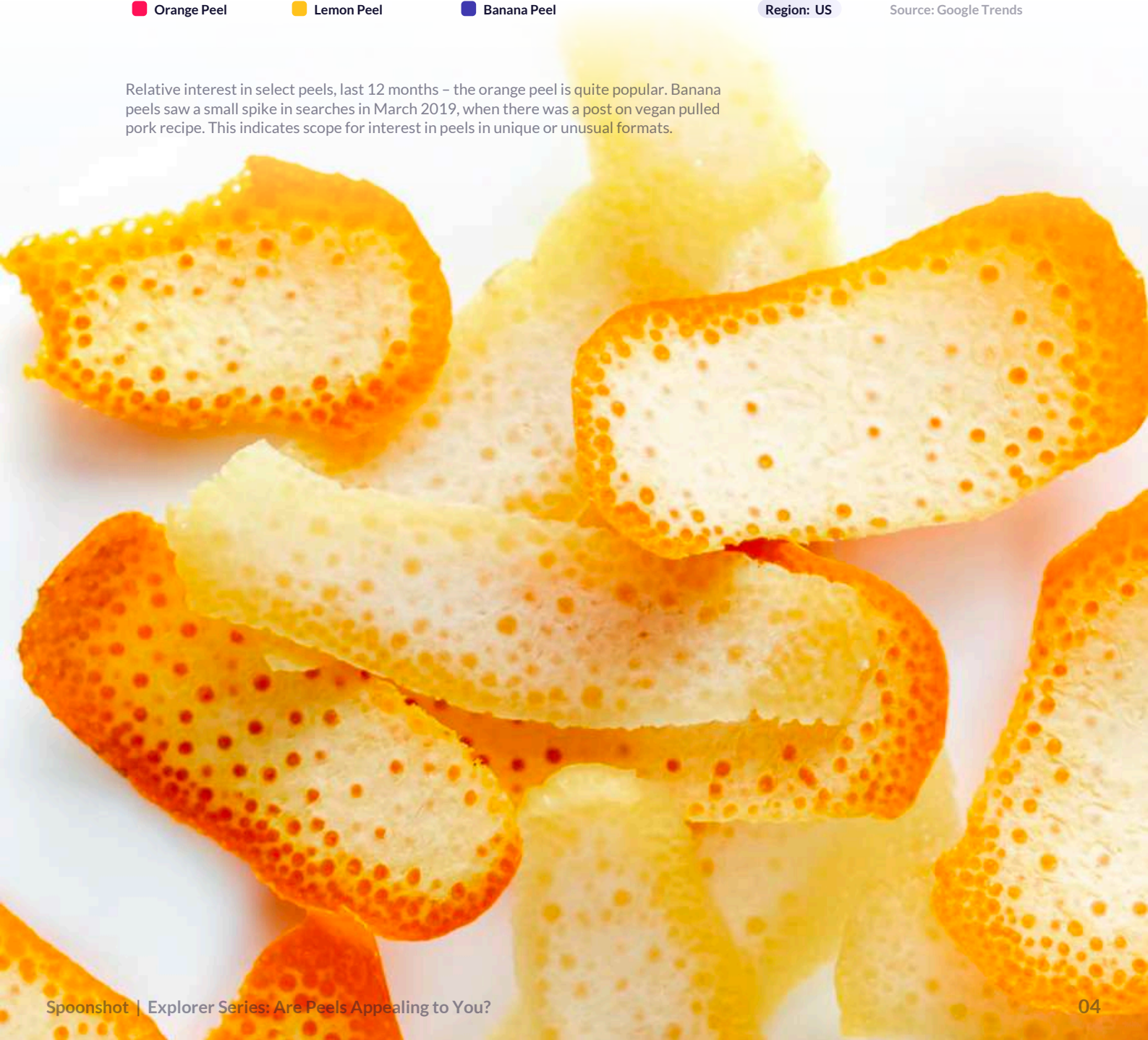
There does appear to be a growing interest in consuming peels. A search for “peel as food” has seen significant growth in the last few years, with the number of hits tripling between 2015 and the first eight months of 2019



Orange Peel Vs Lemon Peel Vs Banana Peel



Relative interest in select peels, last 12 months – the orange peel is quite popular. Banana peels saw a small spike in searches in March 2019, when there was a post on vegan pulled pork recipe. This indicates scope for interest in peels in unique or unusual formats.



FOOD WASTE HAS BECOME A GLOBAL CONCERN

In light of growing food insecurity in many parts of the world, food waste has become a primary global concern over the last couple of years. The **United Nations' Food and Agricultural Organization (FAO)** estimates that around one-third¹ of the total food produced globally is lost or wasted every year, including at least half of the fruits and vegetables produced. Food is lost in every part of the supply chain, but studies indicate that private households² are the main culprits in the developed world.

Consumers are looking to eat healthier, but this comes at a price. A seven-year-long study³ by the **US Department of Agriculture (USDA)** found that the healthiest Americans are also the most wasteful, since they buy large quantities of fruit and vegetables, but frequently throw out a lot of them. The study tracked **22 food groups** and confirmed that fruits, vegetables, and mixed fruit and vegetable dishes accounted for **39%** of the total waste. In all, the study estimated that the US wastes **150,000⁴ tons of food daily**, equivalent to around one pound of food per person every day.

Daily Food Waste In USA

150,000
TONS

1 <https://www.downtoearth.org.in/news/health/each-year-half-the-fruits-vegetables-world-produces-are-wasted-fao-62085>

2 <https://www.sciencedirect.com/science/article/pii/S09592652618303366>

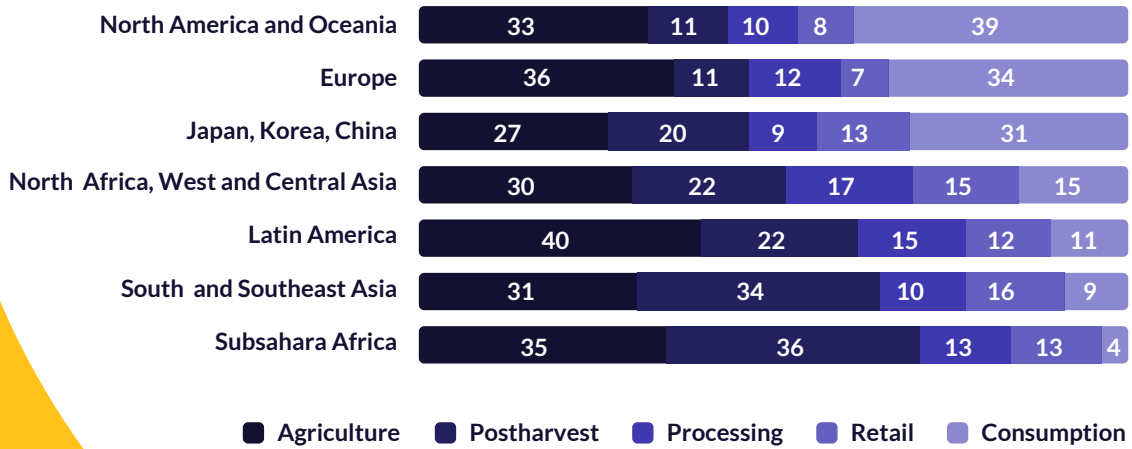
3 <https://www.theguardian.com/environment/2018/apr/18/americans-waste-food-fruit-vegetables-study>

4 <https://consumer.healthday.com/vitamins-and-nutrition-information-27/food-and-nutrition-news-316/americans-toss-out-tons-of-fruits-and-veggies-732988.html>



Processing industries are trying to reduce waste from by-products, but their solutions are concentrated around making animal feed, composting, anaerobic digestion (to produce biogas), incineration, and landfill. Solutions to harvest essential nutrients from scraps or upcycle them are still part of on-going research, but a few companies have made strides in this space as well. **Renewal Mill**, for example, upcycles okara, the pulpy byproduct of soymilk manufacturing, into a nutrient-rich flour and cookies.

How food is lost varies by region



Source: U.N Food and Agriculture Organization

In the UK, **7.3 million tons⁵** of food was wasted in 2015, of which 60% was deemed “avoidable” (food and drink are thrown away because it is no longer wanted or has been allowed to go past its best) and **17%** was considered “possibly avoidable” (food and drink that some people eat and others do not, such as potato skins and apple peels).

7.3

MILLION TONS

of food was wasted
in 2015

⁵ http://www.wrap.org.uk/sites/files/wrap/Household_food_waste_in_the_UK_2015_Report.pdf

It isn't all bad, however. Consumers are increasingly concerned about their role in food waste, and many are actively working on cutting down the amount of food waste they generate. The **2019 Michigan State University Food Literacy and Engagement Poll** found that **88%** of respondents took action to reduce food waste in their homes.

This included steps such as:

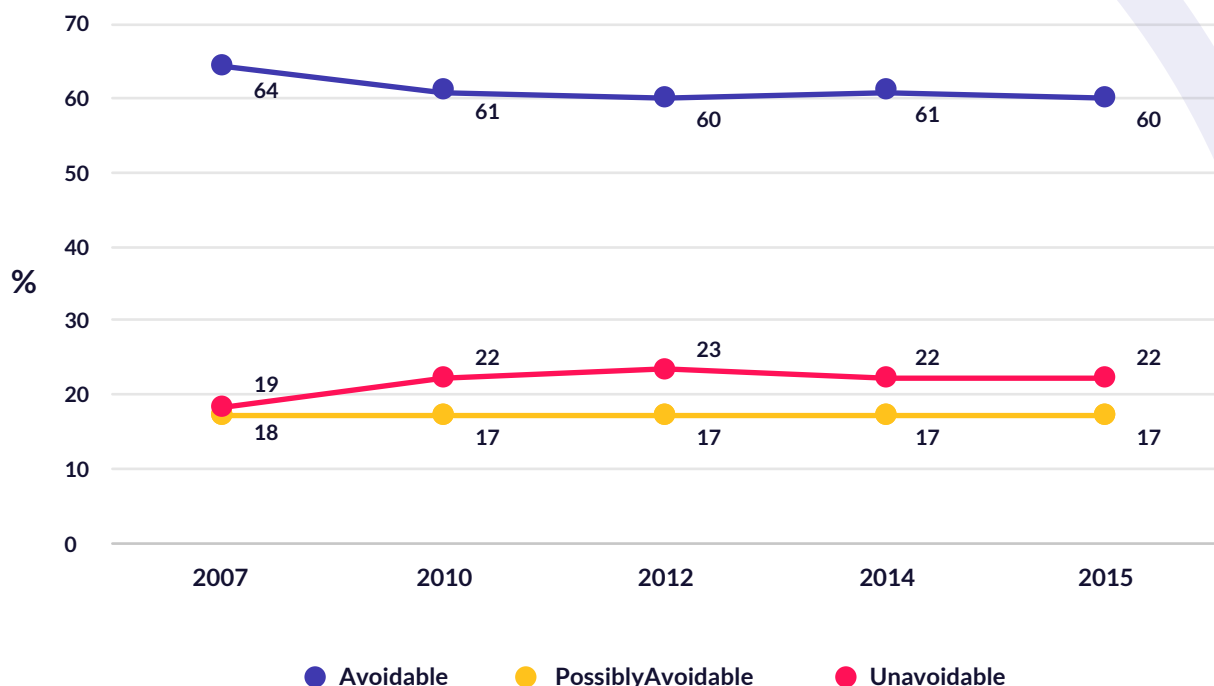
- Ensuring food is eaten before it goes bad (71%)
- Not buying too much food (71%)
- Sharing it with others (34%)

88%

of respondents took action to reduce food waste

The **Waste and Resources Action Programme (WRAP)**, which runs initiatives to tackle food waste and sustainability concerns in the **UK**, found that the share of avoidable food waste is declining. Efforts that aid consumers in upcycling avoidable kitchen waste – like peels – can go a long way in helping cut down overall food waste at home. As consumers attempt to cut down their kitchen waste, they will gravitate towards brands that are doing the same.

Household food waste, by avoidability, UK



FOOD WASTE ISN'T JUST ABOUT FOOD WASTE

The impact of food waste is a lot more complicated than just mounds of piling-up garbage. Food production is expensive and uses a significant amount of resources for production, harvesting, storage, and distribution. With food wastage, the resources that have gone into producing it are wasted as well. This includes cultivated land, water, pesticide and fertilizer costs, labor, and energy costs. According to the **FAO**, the financial, environmental, and social impact of food waste costs the world \$2.6 trillion every year, around twice the expenditure⁶ on food in the US.

The **Natural Resources Defense Council (NRDC)** has quantified the loss of “embedded resources” resulting from **food waste** in the US. This includes losses the equivalent of:

— **18-28%**

of cropland area used to grow food

— **21-33%**

of agricultural water use

— **19-27%**

of fertilizer used (much of which is synthetic rather than compost)



⁶ <https://www.nrdc.org/sites/default/files/wasted-2017-report.pdf>

TRILLION
\$2.6

Every year food waste
costs the world

There are ways to better manage food waste, right from upcycling to composting, but these are limited in practice. The **NRDC** report states that only a fraction of all food waste in the US – approximately **5%** – is recycled by composting or anaerobic digestion. Much of the food waste generated by households and industries end up in landfills, and the ecological consequences of this are worrying as well.

In light of this, one way to ease the pressure on the environment is by cutting down on avoidable food waste, which means consuming a lot more peels than we currently do.



NUTRITION IS SKIN-DEEP



Another reason for eating peels is because they are a nutritional powerhouse.

Fruit and vegetable peels contain significant amounts of fiber, vitamins, minerals, and antioxidants. They also contain phytochemicals, which are the active ingredients in plants that aid growth as well as defend the body against pathogens. Non-peeled versions of fruit and vegetables are significantly more nutritious than their peeled counterparts.

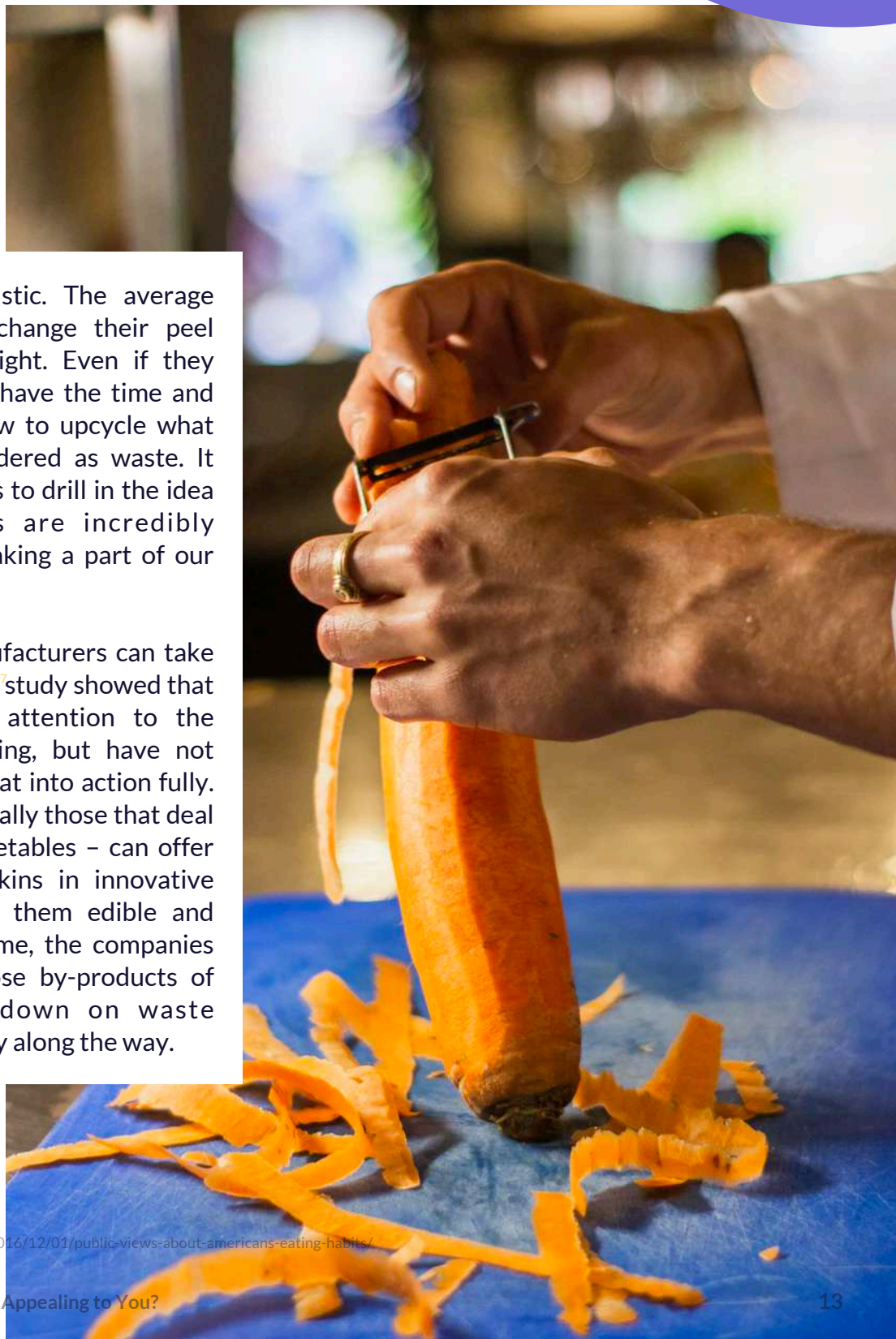
Dietary fiber is essential for the prevention, reduction, and treatment of chronic diseases, such as gastrointestinal disorders, obesity, diabetes, and cardiovascular disease. Fiber also promotes physiological functions like lowering blood triglycerides and glucose control.



While you cannot eat most peels, several fruits and vegetables can be safely consumed with the skin intact or just the skin separately. Peels themselves could go a long way in terms of improving the nutritional profile of populations as a whole. According to the UN, one person in every four across the world now struggles to eat “safe, nutritious, and sufficient food,” and this includes about 8% of people in developed nations in North America and Europe.

This is where we believe peels can step in and make up for the micro- and macro-nutritional shortfall in people’s diets. Today’s consumers are health-conscious and well-informed regarding nutrition needs. This has led to the boom in the protein market and the ever-growing demand for newer and cleaner sources of quality protein. With increased awareness about micronutrients, it is only a matter of time that consumers will start looking at natural food sources to provide them with a healthy dose of vitamins, minerals, and other micronutrients.

SHOW SOME SKIN



However, let's be realistic. The average person isn't going to change their peel discarding habits overnight. Even if they want to, many may not have the time and energy to figure out how to upcycle what they have always considered as waste. It will require a few nudges to drill in the idea that peels and skins are incredibly nutritious and worth making a part of our daily diet.

This is where food manufacturers can take the lead. A **Pew research** study showed that Americans are paying attention to the concept of healthy eating, but have not been able to translate that into action fully. Food companies - especially those that deal with fresh fruit and vegetables - can offer consumers peels and skins in innovative formats that can make them edible and exciting. At the same time, the companies will be able to repurpose by-products of processing and cut down on waste generated, making money along the way.

⁷ <https://www.pewresearch.org/science/2016/12/01/public-views-about-americans-eating-habits/>

There are food companies that have built successful businesses from the by-products of their food processing. Artisanal yogurt brand **White Mustache** harvests its whey water by-product into a separate line of all-natural probiotic tonics and whey pops infused with fresh fruit.



<https://whitemoustache.com/#products>

25-30%

By-products from fruit and vegetable processing industries are estimated to account for around 25-30% of the produce.

Manufacturers of fruit juice, jams, spreads, sauces, and frozen/cut produce can take a leaf out of this yogurt maker's book. By-products from fruit and vegetable processing industries are estimated to account for around 25-30% of the produce. They include seed, skin, rind, and pomace, most of which end up in landfills even though they may be valuable sources of bioactive compounds and nutrients. Instead, these parts can be used to increase the nutritional profile of final foods or be sold as supplements to add to other homemade foods.




One of the largest applesauce makers in North America, **Leahy Orchards**, does just this. Apple peels are a by-product of the applesauce industry, and much of it often ends up in the compost. The company utilizes a processing technique developed at **Cornell University** to convert apple peels into powder. The company sells this apple peel powder as a dietary supplement to functional food and beverage companies under a brand called **AppleActiv**. A clinical study⁸ of the apple peel powder found that **4.5g** can significantly improve joint comfort and mobility in adults after **12 weeks** of use, allowing the company to make this claim.

Research is currently being conducted on the use of banana peels as a functional ingredient and how banana peel flour⁹ could be used as a substitute for wholemeal flour to make bread. Such studies allow for valid on-pack claims of higher nutritional benefits, which in turn will likely appeal to consumers on the lookout for convenient ways of eating healthy.



8 <http://www.appleactiv.com/products/appleactiv-dapp>

9 https://www.researchgate.net/publication/279921919_Banana_peel_flour_an_alternative_ingredient_for_wholemeal_bread



Technology is also evolving in the food processing space with the explicit aim of increasing the lifespan of food without losing out on the nutritional benefits - thus, anyone can reap the benefits of peels.

Treasure8 is a San Francisco-based food tech start-up that has come up with a cost-effective technology that uses an infra-red dry blanching technique to dehydrate fruit and vegetables, while also preserving their nutritional benefits. Companies that find themselves with a large number of peels as by-products will benefit from investing in such technologies to improve the quality of their food as well as tackling food waste. With growing concern surrounding food waste, this is a good time for companies to highlight that they too are doing their bit for the planet.



PEELS WITH POTENTIAL

Now that we've established that peels have the potential to be a money-spinner for food processing and related companies, let's take a look at what peels can make this transition.

You might ask why use peels in a processed format at all? Because raw peel can be hard to digest, and not everyone may be in a position to bite into them or enjoy them in their original form. However, that's no reason to not enjoy the benefits of peels in other formats.

Peel-based products can be sold directly to the consumer as well as be used as simple add-ons to teas, soups, smoothies, desserts, and a range of other dishes, much like seasoning. There is also scope to position peels as alternative cooking ingredients. Interestingly, the **USDA** study that tracked food waste in the country found snacks and condiments accounted for only **3%** of wasted food. This points to opportunities for peels and scraps to find their way into snacks and condiments.

EMERGING PEELS

We believe that the following peels have the potential to break out as functional - and fun - foods in the coming years.



Apple peel:

An apple with skin has significantly more vitamin K than a peeled apple, as well as more than double the vitamins A and C. Research¹⁰ has even found that apples have high antioxidant activity and can inhibit the growth of human cancer cells in-vitro. Another in-vitro study indicates that apple peels contain vital compounds that could impede the growth of prostate cancer.

Use: Fresh peels can be used to make apple cider vinegar, while dried or desiccated peels (whole or powdered) can be put to a host of uses, right from adding to tea for the flavor to add to smoothies and desserts.

10 <https://www.ncbi.nlm.nih.gov/pubmed/12617604>

Potato skin:

Potatoes with skin, for example, have nearly three times as much vitamin C as potatoes without skin. The former also contains more than double the amounts of potassium, folate, magnesium, and phosphorus than peeled potatoes.

Use: Potato skin chips or fried potato skin snacks are popular among home chefs and can quickly be adapted by any food industry that uses potatoes.



Banana peels:

Banana peels contain serotonin, a hormone that helps regulate mood and potentially combat depression. A study showed that banana peel extracts exhibited antidepressant-like effects on mice, pointing to the need for greater investigation. They also contain lutein, an antioxidant that aids retina regeneration, a nutrient of particular interest today due to the time we all spend glued to screens.

Use: Banana peels can be added to smoothies, brewed into tea, made into dips, or used as a meat alternative.



Citrus peels:

Polymethoxyflavones are a class of flavonoids found almost exclusively in citrus fruits like orange and lemon, especially in their skin. In early 2019, the **National Institutes of Health** awarded a **US\$1.5** million grant to a study¹¹ that looks at how these citrus compounds could help decrease colon inflammation. The study expects to show that the consumption of citrus peels – or supplements derived from citrus peels – can help improve human gut health or combat conditions like irritable bowel syndrome.

Use: Orange and lemon zest can be added to anything from baked goods to salads, jams and spreads, tea, or just candied and eaten as a snack.

11 https://www.eurekalert.org/pub_releases/2019-02/uoma-set022219.php

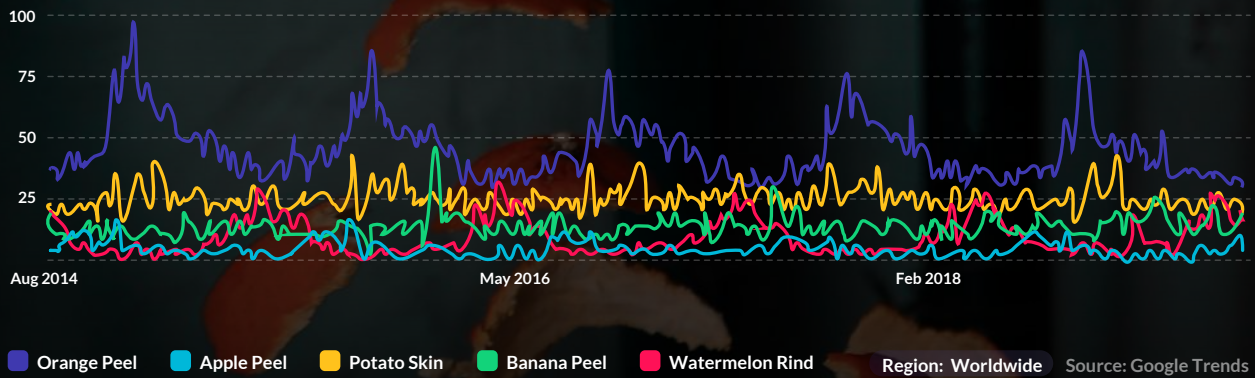
Watermelon rind:

The white fleshy part of watermelon contains a high concentration of citrulline, which is said to have antioxidant properties that can protect from free radicals. Citrulline converts to arginine, an amino acid essential for the heart, circulatory system, and the immune system.

Use: Watermelon rind pickles are famous in several parts of the world, but these are usually homemade, indicating the scope for a retail product that would open up the recipe to a broader audience.



The comparative appeal of select peels



Other peels also offer significant nutritional benefits, but consumers first need to become used to the idea of peels being palatable. Once this has been established, other less commonly eaten peels will emerge to satisfy the more experimental consumer. A few other peels with nutritional potential include those of onion, avocado, kiwi, pomegranate, carrot, and radish.

Another simple option for manufacturers is to keep the skin on the fruit or vegetable. For example, making potato chips with the peel on or creating fruit snacks with the skin intact, similar to what Rind Snacks in the US has done.



Consuming peels and skins of fruits and vegetables has significant nutritional benefits and can offer a viable, sustainable solution to cutting down on the food waste we generate, both at home and in industries. Incorporating peels as a new ingredient can go a long way in improving consumer acceptance of eating fruit or vegetable peels and skins. In the long run, we can expect to see peels become a feature in most fruit and vegetable dishes, both homemade and in retail.

ABOUT SPOONSHOT

Spoonshot is a food AI company that is raising the bar for insight-led innovation. Spoonshot's belief is that exploration is the catalyst behind the novel, successful products, the very fuel to help food and beverage companies shape the future, to set the trend.

Spoonshot equips the food and beverage industry with unprecedented foresight of emerging market needs. By transforming long-tail, open information from diverse, authentic sources, Spoonshot's proprietary food science infused algorithms connect disparate data sets, to deliver personalized insights, predict trends, and identify novel opportunities. Today, Spoonshot is supporting the world's best-known brands in meeting the future needs of its customers. For more information, please visit <https://spoonshot.com>

To request a demo of our AI-powered insights platform, send us an email at hello@spoonshot.com



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