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THE SCIENCE OF TASTE

By Lee Murphy, MS-MPH, RDN, LDN

Food taste is arguably one of the most critical considerations in individual food preferences. Consumer surveys confirm that taste is the single most important factor guiding consumer food choice.[1] However, in the context of health, this observation poses several different questions: How do individuals perceive tastes differently? Are humans predisposed toward developing certain taste profiles? And, if so, are individual tastes and/or food preferences linked with disease risk and health outcomes?

Perceived Differences in Taste

The physiological science involved in taste is intricate and dynamic. The process begins with chemosensory signals, originating from the taste buds in the mouth which are conveyed to the brain. These signals are processed to generate conscious taste sensations through receptors and channels for the 5 basic tastes—sweet, salty, bitter, sour, and umami.[2] While most individuals are very familiar with the commonly discussed sweet, salty, bitter, and sour flavors, umami is less often described. Although recognized for a long time in Japanese culture as an active principle in foods such as seaweed, the savory taste of umami is uniquely different from the classic 4 basic tastes.[3] However, one challenge in describing any of these basic tastes is our natural impulse to create descriptions using our own words and perspectives.

Common food flavors can consist of up to hundreds of different compounds that together create a distinguishable flavor, such as "barbeque" or "orange". Additionally, our other senses of smell, touch, and sight significantly contribute to our overall perception of food recognition and likeability. However, it is important to note that there are certain food characteristics that are correlated with particular food tastes. For instance, the sweetness of food is positively associated with the presence of mono- and disaccharides; salty taste is positively associated with the presence of sodium; and umami taste is often correlated with the presence of protein.[4] Nevertheless, the association between nutrient content and taste seems to vary amongst foods, and this association tends to be weaker in more complex foods.[5,6]

Taste Liking and Causality

A wide range of studies display that food *liking* includes an association with basic taste qualities. Further, food preferences have been found to develop with experience based on associations formed between food flavors and the consequence of their consumption.[7,8] Research attributes differences in these taste perceptions to multiple factors. Studies have pointed to genetic polymorphisms in taste-related genes, as well as to physiological differences, sex, age, and lifestyle habits.[9-12] Additionally, through the evolutionary process, perceptions of diverse tastes have been vital for ensuring adequacy for nutrient intake (such as sweet for carbohydrates, salt for minerals, and umami for proteins), and minimizing risk of ingesting potentially harmful substances (such as bitter for some toxins and sour for spoiled foods).[13]

Taste Perceptions and Risk of Disease

As humans age and the prevalence of chronic disease increases, sensory acuity reportedly changes for both taste and smell.[14] These changes can have an impact on food intake. Subtle differences in sensory quality and intensity can influence eating behaviors, as well as total energy consumption. For instance, although sweet and salty tastes are generally known to increase palatability and overall caloric intake, when tastes are varied within a meal, adults have been found to eat less of the more intense-tasting meal and feel more satiated.[15] Understanding how these factors affect over/underconsumption, for instance, could be central to the development of food-based approaches to prevent conditions such as obesity and type 2 diabetes across the lifespan.[8]

Additionally, although taste perceptions may change over time, these changes may not be caused exclusively by aging. Research suggests that decline in chemosensory perception as individuals age may be due more directly to factors such as poor health status or cognitive decline, rather than the direct effect of age.[16]

With individualized variability in gauging taste measurements over time, it is often difficult to quantify specific taste perceptions as related to overall health and disease risk. Therefore, just as dietary analyses of nutrients have shifted over time towards *dietary patterns* versus single nutrients,[17] a similar approach to studying taste perceptions has been examined through *"taste perception profiles."* Gervis et al.[18] attempted to address this issue by developing a data-driven clustering approach to derive *taste perception profiles* from taste perception scores and examined whether profiles outperformed total taste scores for capturing individual variability in taste perception. These authors concluded that among older adults with metabolic syndrome, taste perception profiles may provide a valuable approach to capture individual variability in perception of all 5 tastes and their collective influence on diet quality. As such, the ability to classify individuals into *taste perception profiles* may help identify subgroups of individuals at elevated risk for certain diet-related chronic diseases.

Summary

While the seemingly innate liking for sweet and salty tastes can sometimes lead consumers to certain foods, taste preferences and subsequent food choices play a major role in overall food consumption. Individual history, perceptions, and lifestyle factors may all be involved in food choices. More research is needed on strategies to investigate and quantify taste preferences and *profiles* that may ultimately impact food consumption patterns, as well as disease risk and/or positive health outcomes.

ABOUT THE AUTHOR

Lee Murphy, MS-MPH, RDN, LDN, is a Distinguished Lecturer in the Department of Nutrition at the University of Tennessee. She has practiced as a public health nutritionist for more than 20 years. Lee also works as a media spokesperson, community/personal consultant, speaker, facilitator, and health educator regarding a variety of public health nutrition issues. Additionally, she has recently published an Introductory Nutrition textbook with an accompanying online dietary analysis program.

SOY'S PATHWAY TO TASTE AND FUNCTIONALITY

Q&A with Bob Sinner

All soyfoods start with a simple bean, but not all beans are created equal. Soybeans *(Glycine max)* come in different varieties depending on the intended end use, and variety selection can affect a soyfood's flavor, appearance, and texture. We asked global food-grade soybean producer and marketer Bob Sinner with SB&B Foods, a family-owned producer, processor and supplier of food grade crops to markets around the world, about what attributes lead to a premium end product.

What soyfoods are driving the industry, and what soybean variety attributes contribute to a premium product?

The 2 main products globally are tofu and soymilk, and for the most part soymilk is driving the industry. Each company wants different attributes in their soybeans depending on what they are making and the methods they use. Making soyfoods in many ways is an art. Each soyfood manufacturer has its own unique way of making products, and may tweak their processes a little bit so that their product is somewhat different than another company's.

When you make soymilk, you can also convert it to tofu, simply by adding a coagulant. A lot of soybean varieties that are good for soymilk can also be used for tofu. However, you get a better yield in tofu from a higher protein bean, but that isn't necessarily the most desirable for the soymilk industry. They may want a little higher sugar content and maybe a little less protein. Protein in those 2 products is still important, but taste, color, and texture are crucial characteristics of a good retail product. Nutrition is one thing, but it is important to make a product that people will want to eat or drink.

The first time people try soymilk they may not like it; especially if it's not flavored. The beany taste in some products can be overpowering for some. For the most part, that flavor comes from the lipoxygenase enzyme in the soybean. Companies can enhance taste in one of 3 ways: adding sugar and flavors, implementing different processing methods, or using a variety of soybeans that have lower lipoxygenase levels.

Tell us about the soybean varieties used to make soyfoods. What are soyfood companies looking for when it comes to the beans they use in their products?

It's never one size fits all. Suppliers need to have varieties with good agronomic values, such as high yields and disease resistance, and ones that can make a good soy product. At our laboratory, we can test different varieties and learn about the characteristics of soymilk and tofu to provide the best soybean variety options to food manufacturers. Different varieties of beans provide a wide array of attributes and can vary in size, color, seed coat thickness, protein amounts, sugar levels, and oil levels. Even the hilum, which is the small growing point on the bean where it attaches to the pod, can be a factor. In applications where the beans are not ground up, many food companies want a hilum that is clear or white, as opposed to darker, to develop a more aesthetically pleasing end product. We always try to provide food companies with the right beans for their applications.

In what ways are soy's taste and functionality affected through processing?

There are different methods for processing soyfoods, even if the end product is similar. Let's look at soymilk as an example.

The traditional way to make soymilk is to soak soybeans for 6-8 hours. With the soybeans now at approximately 80% water, they are run through a grinder to make a slurry. Manufacturers then separate the liquid, which is raw soymilk and not yet drinkable. The raw soymilk must be boiled to destroy the trypsin inhibitors, which can reduce the digestion and absorption of proteins. At this point, you can now fortify the soymilk with nutrients like Vitamin D or calcium, and package it for sale.

Modern soymilk producers often start out by neutralizing some of the soybean's beany flavor by de-hulling them. In addition, rather than soaking the beans, they will run them through a heat chamber or even add steam. They raise the temperature of the soybeans high enough to deactivate the enzymes, and then they'll add hot water before grinding. Such early heating or steaming, along with hot water, takes care of the enzymes and significantly reduces beany flavor. This process is considered a bit more sophisticated.

The market for soy-based products is constantly changing and evolving to meet consumers' needs. What are some of the exciting products you've seen recently?

Entrepreneurs in the United States are bringing traditional soyfoods like freshly fermented natto to our markets, as well as perfecting new plant-based meat alternatives made from soy that mimic the flavors and textures of animal proteins. Food makers internationally are also developing new ways to use soy. I met with an overseas company in August 2022

that is making soy wine. I've also seen food makers offer a twist on traditional soyfoods, like tofu bars which are snack bars made from tofu and flavored with spices. There is so much innovation and many new products that soy consumers can get excited about!

ABOUT THE AUTHOR

Bob Sinner is a soy industry entrepreneur who, 30 years ago, persuaded his SB&B family partners that his passion to work directly with global food companies was worth the effort, boarded a plane for Asia, and now looks back in disbelief at how SB&B has evolved into a leader for the supply of U.S. identity preserved food quality soybeans.

UMAMI AND SOY

By Jackie Newgent, RDN, CDN

Taste is complex. There are 5 basic tastes: sweet, sour, salty, bitter, and umami. Umami is perhaps the most intriguing. In fact, some researchers separate it from the basic tastes and classify it an "alimentary" taste along with fat.[1]

Kikunae Ikeda identified this deliciously savory, "meaty" taste about 100 years ago,[2] but umami is not actually a single taste. There are 3 key types of umami compounds: inosine-5'-monophosphate (IMP), guanylo-5'-monophosphate (GMP) and, the most well-known, monosodium glutamate (MSG).[2] The tongue has taste receptors that detect these compounds.

Umami goes beyond taste. When detected, it may increase salivation, food palatability, and appetite, and it may play a role in boosting diet quality.[2,3] Research suggests this novel taste's potential may also enhance satiety.[2]

Top food sources of umami include Parmigiano-Reggiano cheese, kelp, fish sauce, tomatoes, scallops, green peas, dry and fresh mushrooms, green tea, and most notably, fermented soybean products (including natto, tamari, tempeh, and miso).[2-9]

There are many ways to savor the umami flavor of soyfoods:

- Natto (fermented soybeans) heightens cuisine appeal when mixed with other ingredients. Stir natto with mayonnaise and mustard for a sassy sandwich condiment. Mash natto with avocado for Korean-style avocado toast.
- Tamari (soy sauce from fermented soybeans) adds zing to lunch-time Chinese takeout – but also try it at breakfast-time. Top steamed rice with a fried egg, scallions, and a generous splash of tamari. Serve oatmeal savory-style (like "ris-oat-o") with asparagus tips, sesame seeds, and a drizzling of tamari.
- Tempeh (fermented soybean "cake") mimics meat's chewiness in stir-fries. Crumble and prepare it like ground meat for tacos, burritos, or chili.
- Miso (fermented soybean paste) can take basic soup, sauce, dip, or even mashed potatoes from plain to pow. Sneak a spoonful into brownie batter or cookie dough to bake up a wow-worthy dessert.

The bottom line: umami and soyfoods add intrigue to the plate and palate. The nutrients found in these soyfoods can offer bonus health benefits such as anti-diabetic, anti-neuroinflammatory, and serum cholesterol-lowering effects too.

ABOUT THE AUTHOR

Jackie Newgent, RDN, CDN, is a plant-forward registered dietitian nutritionist, classically-trained chef, award-winning cookbook author, professional recipe developer, media personality, spokesperson, and food writer. She's a Forbes Health advisory board member, nutrition contributor to TheHealthy, and former national media spokesperson for the Academy of Nutrition and Dietetics.

APRIL IS SOY FOODS MONTH

Celebrate Soy Foods Month by enjoying this soy-inspired recipe

Soy Foods Month by U.S. Soy

Caribbean Crispy Tofu Pineapple Bowls

Created by Sylvia Klinger, MS, RD, DBA, LDN, CPT

NUTRITION FACTS
Serving size:
1/2 cup rice + 1/2 cup tofu
Per serving:
463 calories, 16.5g protein, 69g carbohydrates, 4g dietary fiber, 11g total fat, 2g saturated fat, 47mg cholesterol, 791mg sodium, 430mg potassium

INGREDIENTS

- 1 large pineapple, halved lengthwise, stem on
- ½ cup all-purpose flour
- ½ cup cornstarch
- 2 large eggs, beaten
- **1 (16 oz.) firm tofu, drained and cut in cubes**
- ½ cup 100 % pineapple juice
- **1/3 cup low sodium soy sauce**
- 1 tablespoon honey
- ¼ cup brown sugar
- 1 teaspoon ground ginger
- 1 tablespoon cornstarch
- 2 cups white rice, cooked

DIRECTIONS

1. Remove core and flesh of each pineapple half using a spoon. Save the flesh for a smoothie or for another recipe.
2. In a large bowl, combine flour with ½ cup cornstarch. In a separate medium bowl, beat eggs. Toss cubed tofu in egg mixture and fully coat. Transfer egg coated tofu to flour mixture and toss until fully coated.
3. Transfer coated tofu to air fryer lined tray (or fry with soybean oil) and air fry at 400 degrees F for 15 to 20 minutes or until crispy. Set aside.
4. Meanwhile, in a medium saucepan over low medium heat, add pineapple juice, soy sauce, honey, brown sugar and ginger. Heat for 3 to 4 minutes until bubbly. Add remaining 1 tablespoon cornstarch and stir constantly for about 5 minutes or until sauce thickens. In a large bowl, toss air fried tofu into sauce.
5. To assemble pineapple bowls, add ~1 cup cooked rice to each half, followed by half of crispy prepared tofu.

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Umami and Soy

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The Soy Connection
PO Box 237
Jefferson City, MO 65102
info@soyconnection.com