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Food Preferences

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Synonyms

Human dietary predispositions

Definition

An overview of human dietary preferences, including innate predispositions to favor and avoid certain tastes as well as the role of culture and environment in shaping food preferences.

Introduction

Humans occupy a multitude of habitats on earth – a success possible due to our dietary flexibility, among other things. As omnivores – animals that eat both plants and other animals – we are able to consume a wide range of foods, which is evident in the great variability of diets worldwide. While omnivores or food generalists are not programmed for any specific diet, humans display universal tendencies such as an innate aversion to bitter tastes or fear of new foods – these preferences protect the organism from ingesting possibly dangerous items. Challenging this tendency for caution is the need to explore new edibles in order to vary the diet and prevent nutrient deficiencies. This conflict between an interest in novel foods and a fear of them is a dilemma with which omnivores must deal.

Omnivores and their Dilemma

For omnivorous species, taste is a crucially important sense: with a wide range of potential foods, one could face both nutritional benefits and dangers of toxin ingestion. The proper dietary strategy of our ancestors, Paleolithic foragers, would have been to consume small amounts of different foods to decrease impacts of toxins, pathogens, and poisons (Rozin and Rozin 1981). The need for dietary variety is hard-wired biologically (Rolls et al. 1982), and its goal is a balanced diet with an adequate range of micronutrients, as well as limited toxin ingestion (Remick et al. 2009).

The drive to explore novel foods leads to a conflict between neophilia (interest in and liking the unfamiliar) and neophobia (fearing and avoiding it), called the “omnivore’s dilemma” (Rozin 1976; Rozin and Rozin 1981). Neophobia is adaptive as it can protect against illness or death from poisonous foods, but it limits dietary variety, possibly causing deficiencies. Learning through experience, though, can override the fearful response to the new – a food first rejected can

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become a preference (alternatively, a negative experience can lead to rejection of the previously liked food item). Cuisine – a cultural system that defines edible foods and how to eat them – is another way to deal with neophobia, making every meal familiar and thus nonthreatening (Rozin and Barker 1982). Variety is additionally ensured with palate fatigue, a sensor-specific satiety that prevents one from fixating on a food item and limiting the diet (Rollo and Marota 1999).

Innate Preferences Through Taste

Being able to taste is so important to an omnivorous eater that the taste system is the most durable of all sensory systems – the taste bud and gustatory epithelium (the taste organ) are one of the very few human organs capable of total regeneration (Fausto et al. 2012). An inability to sense flavors can lead to ingestion of rotten or poisonous foods with a potentially lethal outcome to the organism. There are five tastes detected by most mammals: sweet, salty, sour, bitter, and savory (or umami). While other nutrient taste qualities have been suggested, such as receptors for fatty acids, there is little agreement on whether they can be described as unique tastes yet.

The tastes of sweetness and its opposite, bitterness, display universal preferences with humans being quite fond of sweet tastes, while avoiding bitter ones. The preference for sweet foods is seen with both newborns and adults, who have an attraction to moderately strong sweet sensations. These preferences make sense as, in nature, most sweet foods are fruits and are thus easily digestible sources of calories. Over millions of years, these food sources of sweetness were rather limited, making the modern abundance of refined sugar a very recent and unusual event.

Moderately bitter tastes are rejected by newborns with an innate aversion. The human ability to taste, dislike, and avoid bitterness is considered adaptive, since many toxic compounds are experienced as bitter. Most naturally occurring bitter compounds are toxins at certain higher concentrations, and for stronger bitter tastes the body responds as if a toxin were about to be ingested (e.g., with vomiting). For weak bitter tastes, such a response is not present since normal foraging behavior would require some habitual intake of moderate bitter tastes. With a varied diet, various toxins contained in plants should not become problematic, as we would not ingest enough of them to cause harm. Besides, bitter plant compounds are often beneficial and have medicinal properties (e.g., antioxidants). Bitterness is also experienced with free fatty acids in foods as they are involved in food deterioration – the ability to detect these may reflect an adaptation against eating spoiled foods containing oxidized fats (Drewnowski and Almiron-Roig 2009).

The ability to sense bitterness is a variable trait in humans, as there is genetic variation between populations in how sensitive they are to bitter taste. Specifically, people have been found to differ in their response to PTC – a bitter chemical phenylthiocarbamide. Half of the population is estimated to be tasters (able to taste PTC), 25 % are considered supertasters or those very sensitive to the chemical, and the remaining 25 % are classified as nontasters (Bartoshuk 2000). The receptors involved in this variation respond to plant secondary compounds (those made by the plant to be poisonous or unpalatable to predators), and supertasters with their high sensitivity tend to dislike vegetables containing such bitter compounds. These foods include many cruciferous vegetables like broccoli, whose secondary compounds can be beneficial for health.

Having moderate sensitivity to bitterness would seem like the best solution – one would avoid strong bitter-tasting foods yet still include health-promoting plants with low levels of natural toxins. However, being a nontaster could also be advantageous under certain conditions. Having such low sensitivity has been hypothesized to be protective for individuals living in endemic malaria regions of Africa, as some secondary plant compounds in the area have antimalaria effects. The protection from eating such bitter plants would outweigh the danger of poisoning (Soranzo et al. 2005). Nontasters are also less sensitive to strong spices, which could present another benefit – protection from microbial food contamination. Sherman and Hash (2001) analyze spice use in relation to ecology and show a pattern of increased spice use in hotter climates. This pattern is only true for spices that inhibit bacterial growth and only in dishes made with meat. Thus, cultural preference for spicy food appears to have risen due to their antimicrobial properties.

Lastly, our preferred tastes include salt and savory. Humans begin showing a preference for a salty taste around 4 months of age, and moderate salt concentrations in food are highly attractive to us (Breslin et al 1995). As humans lose salt through sweat, they prefer a higher intake of salt than other omnivores. The savory (or umami) taste is another important preference and is found in many cooked and fermented foods. Cooking and fermenting increase availability of glutamate, an amino acid for which humans have developed an affinity. The savory taste of glutamate could be a marker of protein content, though fresh raw protein foods are not in fact savory without the transformation of either heat or fermentation. Thus, fondness of this taste could suggest a preference toward easily digested proteins in cooked or slightly aged meats (Breslin 2013).

Food Palatability

The Maillard reaction – a chemical reaction responsible for browning and flavor production in foods when cooked – increases palatability of many foods (Maillard 1916). Cooked foods in general appear to be preferred to raw ones by humans, and every human culture cooks. We are not the only ones attracted to cooked flavors – great apes also inherently prefer cooked meat and starchy foods when a raw version is present (Wobber et al. 2008). Products of the Maillard reaction have both negative (e.g., carcinogenic, prooxidant) and positive (antiallergenic, antioxidants) impacts on health (Tamanna and Mahmood 2015), but we might have developed defenses against the dangerous byproducts. For example, acrylamide is toxic in mice and rats but appears less dangerous in humans.

Cooking does not simply increase palatability of various foods – it also would have provided omnivores with the most varied dietary choices, allowing us to diversify our diets to items that are toxic or indigestible when raw, in turn expanding the environmental range for human habitation. Because of universal reliance on cooking by all human cultures, Furness et al. (2015) even propose that humans should be classified not as omnivores but cucinivores – species with the dietary specialization of eating cooked or otherwise prepared foods.

The fat content of foods also contributes to its enjoyment and palatability (Drewnowski and Almiron-Roig 2009). Palatability has a direct relationship to nutritional value with high-energy foods receiving higher preference, and fat – the most concentrated source of edible calories – is the reason palatability is so closely related to energy density (Drewnowski 1997). Children learn to prefer flavors associated with high-energy foods rather quickly and begin selecting fatty foods early in life (Birch 1992), as high-fat food items induce the least neophobia (Rankin and Mattes 1996).

Developing Preferences: Genes and Environment

Food processing through cooking, fermenting, and other techniques is an important element of human culture, and several examples illustrate the significance of these behaviors in the evolution of food preferences. Differences in the ability to digest starches are a prominent example of coevolution between genes and culture. The enzyme necessary to digest starchy foods – amylase – is produced in the pancreas by all mammals, but certain few mammals additionally produce it in the salivary glands, which predigests starches in the oral cavity. Humans are unique among these few mammals as we have a higher number of copies of the salivary amylase gene (AMY1). Agricultural advances over the past 10,000 years have increased reliance on starchy grains as staples, which appears to have resulted in increased AMY1 copies for societies with traditionally high-starch diets (Furness and Bravo 2015). AMY1 is not effective on digesting raw starches, however, so it has been proposed that cooking and increased AMY1 copies evolved simultaneously (Hardy et al. 2015), allowing starches to become important reliable sources of extra energy in the diet.

Another example of gene-culture coevolution affecting food preferences is lactase persistence into adulthood. For mammals in general and the majority of humans, the enzyme lactase (necessary to digest lactose, a major sugar in milk) disappears after weaning. However, populations with a legacy of dairying have evolved the ability to digest lactose in adulthood – a trait that has evolved independently both in Europe and Africa in only about 7000 years (Tishkoff et al. 2007; Ranciaro et al. 2014). Development of dairy farming and consumption of milk products into adulthood correlates with the selection for genes that code for the persistence of lactase expression (Perry et al. 2015). Not surprisingly, lactase persistence is a common phenomenon in populations that have a long history of milk production: adult lactase expression is present in 75% of northern Europeans, yet only 5% of populations that hunt and gather in the same regions have it (Malmström et al. 2010). Ability to ingest dairy, as an energy-rich food high in nutrients and water (which would be important in arid climates), could have provided an evolutionary advantage.

Modern Food Environment: The Mismatch

Innate preferences for sweet and salty, as well as rejection of bitter tastes, do not predispose humans to pursue a diet currently recommended by many governments and health agencies – rich in plants yet low in sugars and sodium. The industrial revolution led to an abundance of highly processed and palatable foods. Such items feature not only high sugar, sodium, and fat profiles – a combination highly attractive to humans – but they also bypass sensory fatigue by presenting many flavor variations despite poor breadth of ingredients. One hundred years of rapid dietary changes would not have been enough for humans to adapt adequately in only a few generations (Carrigan et al. 2015). Modern health problems related to these novel processed diets – such as obesity and diabetes – also would not be selected against, since the dietary conditions that facilitate them are so recent in evolutionary history. The dramatic recent rise of these noncommunicable conditions may be due to the evolutionary advantage of having thrifty genes, which increase efficiency of fat storage yet predispose one to chronic disease. According to the "thrifty genotype" hypothesis (Neel 1962), having a large appetite and rapid energy uptake was advantageous in the past, as these traits would have been selected for to deal with feast and famine periods. Such thriftiness would however become harmful in a time of plenty with easy access to unlimited, cheap calories. This hypothesis, however, has received criticism and alternative ones have been proposed, e.g., Speakman (2008) suggests that the obese phenotype is due to genetic drift, not the positive selection of "thrifty" genes.

While human innate preferences appear problematic in the times of plentiful, inexpensive calories, they can be changed and reversed through learning. In addition to the genetic predisposition for certain tastes, humans also possess the predisposition to develop new preferences based on experience with foods – associating foods with context and consequences shapes and modifies preferences. We surely learn to enjoy tastes of some bitter foods like dark chocolate, coffee, and wine; we can also develop an aversion to a previously preferred food, such as after a food poisoning episode. In other words, flavors and tastes that become associated with energy and nutrients become preferred, while illness and poisoning cause associated flavors to be aversive – a process that is not necessarily conscious (Breslin 2013).

Conclusions

An omnivore's eating strategy must account for two needs: to avoid poisoning and death and to ensure a balanced diet without nutrient deficiencies. The taste system plays a major role in ensuring the survival of an omnivore that faces limitless eating decisions. Our innate taste preferences guide this process by disliking and avoiding bitter foods – often containing toxins in nature – and preferring sweet, savory, and salty tastes that signal high caloric values. Sweetness is an indication of easily digested sugars, while savory tastes could indicate protein sources that have been cooked, thus being more digestible and safe from foodborne bacteria. Differences in bitterness sensitivity might reflect important adaptations, such as lower sensitivity in malaria areas leading to higher ingestion of bitter protective plants. Lastly, the coevolution of culture and genes has resulted in the importance of dairy and starches in human diets, as the evolving ability to digest them would have provided an advantage to those who could make these energy-rich food sources a reliable part of their diet. These human food preferences appear maladaptive in the current environment, characterized by access to highly palatable and energy-rich foods, yet they can be modified with learning in order to prevent health conditions associated with overnutrition.

Cross-References

▶ Neophobia

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