Functions of the Sense of Taste

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Food is commonly selected because of its sensory qualities, thus what is introduced into the digestive tract is usually determined by its taste. Despite the relevance of the chemical senses to animal production and the marketing of animal products, little is known about the mechanisms and functions of these senses.

One of the reasons for our primitive state of knowledge about taste and smell is that the research is so difficult. For example, there is enormous diversity in taste among humans and animals. In a single litter of pigs, some will respond positively to saccharin, others may be indifferent and a minority will be offended by the taste. Similarly, in humans, some individuals perceive a bitter component in saccharin which is imperceptible to others.

An individual's response is specific to the chemical and dependent on its concentration. In general, an individual's response to a specific taste or odor, at a specific concentration, will not provide information on his sensitivity to a second stimulus. Response to particular compounds can be genetically determined. For example, identical twins will respond similarly to the chemical which is responsible for making the taste of pork unacceptable to some of the population. Fraternal twins may not respond similarly. Superimposed on this genetic component is an influence by experience.

Animals are commonly thought to share man's sensory world. With a few notable exceptions, most of the high-intensity sweeteners hold no appeal for species other than man. A frequent misconception is that all species have a "sweet tooth." However, among many species that do not avidly consume sugar solutions are the entire cat family, armadillos, gulls and chickens.

It is important to clarify that the response of various species to a taste quality is not an all-or-nothing affair. The domestic fowl does respond to xylose, but the response is not one of mild indifference; the bird finds this particular sugar offensive. By contrast, the cow, with a threshold for sucrose much lower than that of man, responds most favorably to xylose. However, the cow is relatively indifferent to maltose, the most preferred sugar of the rat. This diversity of taste between species is ecologically sound since it reduces the competitive pressure for food in any particular area.

Another complicating factor in studying the chemical senses is that the response to a stimulus is not a constant. After six or seven weeks on a salt-free diet, new levels of acceptability will be established. What was originally an acceptable salt level will become excessive. Caloric deficiency can also modify response and nutritional deficiencies of vitamins A, B_6, B_{12}, nickel, zinc, copper or iron, which have all been reported to affect the sense of taste. Taste functioning has been observed to change characteristically with various disease states. Similarly, side effects of some medications on taste perception have been reported.

External environment, such as thermal input (cold vs. hot meat) and pain (horseradish, mustard), can modify taste. Internal factors that modify food preferences include metabolic hormones and circulating metabolites. Some little-understood phenomena concern animals whose diet changes abruptly; some grainiverous birds become insectivorous only during the breeding season, calves begin life on a high-protein diet and a week or so later change to a herbivorous diet. Whether taste leads or follows these food changes has yet to be established.

The human newborn responds to sugar much as an adult but displays little response to salt until months later. This is one more example of the lack of constancy in taste. These changes in taste seriously complicate the interpretation of research results.

Mechanisms

The mechanisms of taste and smell are currently being aggressively investigated. This is particularly difficult since structure activity relationship of most stimulus categories remains largely unresolved. Progress is being made on transduction and modest advances are being accomplished in understanding processing in the central nervous system. One generalization that is emerging is that the biochemical and biophysical processes of receptor and transduction may be different for different sensory qualities. For example, salt taste is mediated primarily by an epithelial sodium channel, while the tastes for sugars and amino acids are mediated by specific receptor proteins.

There are suggestions that, in the coming decade, research will identify flavor potentiators and modifiers. Current work at Monell has demonstrated that selective elimination of taste is possible. With an understanding of the mechanisms, one can predict that the impact on the food industry will be enormous.

Functions

Taste serves as a gatekeeper, determining what enters the digestive tract. Further, the oral cavity houses sensitive receptors that alert the digestive tract as to the specific nature of the nutrients that will arrive.

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Taste can influence ingestion, digestion and metabolism. Oral stimulation will trigger the respiratory quotient and the character of food may determine both the volume and nature of saliva. The release of metabolic hormones, alterations in biliary and gastric function, as well as activity of the gut, are all under the influence of oral stimulation.

Working with fistulated dogs, one can demonstrate dramatic differences between pancreatic exocrine secretion with aversive and appealing taste stimuli. However, this is only of consequence to the animal if enzyme production were depressed to the extent of not meeting normal needs.

Recently, it has been demonstrated that taste can influence the rate of absorption from the gut. The significance in terms of food utilization is now being investigated.

Summary

Research is beginning to provide details on the mechanisms and functions of taste. Coming out of the Victorian era, appealing tastes were almost categorized as sinful. Certainly, no weight in nutrition was ascribed to sensory appeal of diets.

It is apparent that the taste of nutrients can serve an important role in ingestion, digestion and metabolism. With our new knowledge on mechanisms, it should be possible to control palatability as with other parameters of nutrition. Thus, an era may be in the offing where agriculture will employ sensory quality – as it did vitamins and minerals – for the benefit of both producer and consumer.

References

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Discussion

Question: What can I spray on my lawn to keep the dogs repelled from it?

M. Kare: You know, I think you have a problem there of upbringing. I mean of the dog, not of yourself. None of my colleagues have worked on that specific area. I do notice that they're now using the compound I showed you with birds, which we accidentally developed. They're spraying it on golf courses so that geese won't be attracted to it. Theoretically, it's possible, but I don't have a neat packaged answer for you. Maybe we could motivate one of my colleagues to get the answer.

R. Field: You mentioned that we can put flavor into animals just before they're butchered. Would you give us an example of what you are thinking about?

Kare: Yes, I can give you an example. We took a series of fat-soluble flavors, a dozen of them. We found that the chickens wouldn't eat some at high concentration, but they would eat a few of them. We gave chickens massive quantities in the diet, two days before slaughter; which apparently wasn't too meaningful to them, but is meaningful to humans. The flavors were laid down in the fat.

As it happened, we sent samples out to a big chicken company and they tested them in their panels. One of the replies came back that they didn't like the flavor. But the principle is true. There's no question, we can do it. It'll be laid down in the fat, just as if you finish a hog on peanuts, you get soft fat. Apparently, you can take a variety of flavors and put them into animals for short periods of time and they will be laid down.

Field: The reason I ask is that there's been a lot of debate among our group as to how much diet influences flavor of the meat. I suppose it could vary by species and probably by what they're eating, but I'd appreciate any comment you could have on that.

Kare: With diet, it depends: if you overwhelm the system so it's not converting it to the characteristic fat of the animal, then you would have the stronger impact of the flavor. Normally, animals will convert the materials into their system. In this case, you're overwhelming the system so it's not being processed and the flavor remains.