Chapter 16: Influence of Taste and Other Sensory Perceptions on Food Choices

- **Factors affecting food choices**
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Chapter 16: Influence of Taste and Other Sensory Perceptions on Food Choices

How do we choose what we eat? Our food choices are dependent on various intrinsic and extrinsic factors. The choice we make between a pack of chips or a fruit is not only based on our liking but there are several other factors involved. These factors include intrinsic properties of food like aroma and taste compounds, texture, colour, appearance, and temperature. Psychosocial and cognitive factors such as culture, education, mood, or conditioning also influence food choices. Understanding sensory perception of food is important for food producers. Food brings pleasure and conviviality to our lives and triggers multitude of emotions. The most nutritious food will not be willingly accepted and regularly consumed if it has poor sensory properties. The challenge to the food industry is to fit what consumers want with what they need, delivering nutritional value and health through products they prefer. This chapter addresses the questions- why we eat what we eat and how can we improve the choices we make?

Factors affecting food choices

The key driver for eating is of course hunger but what we choose to eat is not determined solely by physiological or nutritional needs. Some of the other factors that influence food choices include:

- Biological determinants such as hunger, appetite, and taste
- Economic determinants such as cost, income, availability
- Physical determinants such as access, education, skills (e.g. cooking) and time
- Social determinants such as culture, family, peers and meal patterns
- Psychological determinants such as mood, stress and guilt
- Attitudes, beliefs and knowledge about food

The complexity of making food choices is obvious from the list above, which is in itself not exhaustive. Factors affecting food choices also vary according to life stage and the power of one factor will vary from one individual or group of people to the next. Thus, one type of intervention to modify food choice behaviour will not suit all population groups. Rather, interventions need to be geared towards different groups of the population with consideration to the many factors influencing their decisions on choosing food. In this chapter we would focus on biological determinants of food choices.

Hunger and satiety: Our physiological needs provide the basic determinants of food choice. Humans need energy and nutrients in order to survive and will respond to the feelings of hunger and satiety (satisfaction of appetite). The central nervous system is involved in controlling the balance between hunger, appetite stimulation and food intake. The sensitivity of all basic tastes increases during hunger and declines post meal for about one hour. It has been observed to be the greatest at mid- morning. Depletion of body salt

content increases the sensitivity to salt without affecting the other taste thresholds. No significant influence of fasting has been observed in the sensitivity of various taste qualities.

The macro-nutrients i.e. carbohydrates, proteins and fats generate satiety signals of varying strengths. The balance of evidence suggests that fat has the lowest satiating power, carbohydrates have an intermediate effect and protein has been found to be the most satiating. The energy density of diets has been shown to exert potent effects on satiety; low energy density diets generate greater satiety than high energy density diets. The high energy density of high-fat and/or high-sugar foods can also lead to 'passive overconsumption', where excess energy is ingested unintentionally and without the consumption of additional bulk. An important satiety signal may be the volume of food or portion size consumed. Many people are unaware of what constitutes appropriate portion sizes and thus inadvertently consume excess energy.

Palatability is proportional to the pleasure someone experiences when eating a particular food. It is dependent on the sensory properties of the food such as taste, smell, texture and appearance. Sweet tasting and fat-rich foods have a greater sensory appeal. It is not surprising then that food is not solely regarded as a source of nourishment but is often consumed for the pleasure value it imparts.

The influence of palatability on appetite and food intake in humans has been investigated in several studies. There is an increase in food intake as palatability increases, but the effect of palatability on appetite in the period following consumption is unclear. Increasing food variety can also increase food and energy intake and in the short term alter energy balance. However, effects on long-term energy regulation are unknown.

Sensory aspects: 'Taste' is consistently reported as a major influence on food behaviour. 'Taste' is the sum of all sensory stimulation that is produced by the ingestion of a food. This includes not only taste per se but also smell (flavour), appearance and texture of food. These sensory aspects are thought to influence spontaneous food choice.

From an early age, taste and familiarity influence behaviour towards food. A liking for sweetness and a dislike for bitterness are considered innate human traits, present from birth. Taste preferences and food aversions develop through experiences and are influenced by our attitudes, beliefs and expectations. We still remember the foods which we consumed as children -special seasonal dishes like pickles, chutney and the traditional dishes grandma made. We search for that taste only.

Now we know that the process by which we accept or reject food is of a multi-dimensional nature. In complex food matrices, it is not always easy to establish relationships between the body's response, physiological perception, and consumer reaction. Individual's responses to food are not only based on the sensory characteristics of the product and on their physiological status but they are also related to other factors, such as previous information acquired about the product, their past experience, and their attitudes and beliefs.

Though there are several factors involved but sensory quality should be considered as a key factor in food acceptance because consumers seek food with certain sensory characteristics. The acceptance of a food will depend on whether it responds to consumer needs and on the degree of satisfaction that it is able to provide.

One of the proven theories on choice of food we make is that the acceptance of a food is basically the result of the interaction between food and man at a certain moment. The other theory of the influence of consumers ´ decision to accept or reject a food depends on : Food characteristics (chemical and nutritional composition, physical structure, and properties), consumer characteristics (genetic such as taste genetics, age group, gender, and physiological and psychological state) and those of the consumer's environment (family and cultural habits, religion, education, fashion, price, or convenience). Now days the safety of the product also plays an important role in decision making. Extrinsic factors such as advertising, branding, packaging and labelling or price of the product also influence the food choices.

Familiarity is a powerful predictor of liking for food. Unfamiliar foods tend to be disliked. A memory of the flavour helps in identifying foods that significantly depart from what the visual and olfactory cues suggest it should taste like. We relate the place with the food and would not mind travelling the distance to experience that same taste again.

Individuals do not experience the same taste sensations. This variation comes from genetic differences as well as taste perceptions. When a food is placed in the mouth, it may taste pleasant to some if it is sweet (just as it might with mildly salty, fat-related and meaty tastes, although these have been less well explored), and unpleasant if it is bitter or excessively sour. This has been termed flavour–flavour learning.

Role of senses in making food choices

The simple act of putting food in our mouths and beginning to chew signals three different sets of glands to release enzyme-rich saliva, which lubricate the mouth and activate the "tastants"—that is, the chemicals that stimulate our taste receptors—contained within the masticated food. When you eat, the brain receives different sensory inputs. The eyes provide inputs about the appearance of the food, the nose detects the aroma, the taste buds on the tongue detect the flavour, the texture - and the information is integrated in the final sensory perception. For an individual, each perceived sensation would work together and help in choosing the food. In a study by Delwiche (2004) it was reviewed how the consumers make subjective judgments using one or more of the five senses every time they select or eat any food. For example, potato chips, celery, and some cereals have a crunchy sound when they are eaten; the taste and smell of foods can be highly appealing or unacceptable; and the appearance and feel of a food also are important in determining its acceptability.

Ayurveda correlates chemicals with taste. It insists that every meal we eat should have all tastes; the tastes are proof of the presence of certain categories of chemicals. It acknowledges that food should be tasty for it to be consumed willingly. Only tasty food can stimulate our senses. But at the same time, it insists on balancing tastes. Too much of any single taste is not advisable.

Figure 1 depicts the expectations of our different senses when selecting and evaluating a food product.

Figure 16. 1: Role of senses in making food choices

Food quality has both subjective and objective aspects. Appearance, texture, and flavour are largely subjective attributes, whereas nutritional and microbial qualities are not.

Vision

Eyes are the organs that capture the vision- transmit it to the brain where it mixes with memory. Thus, if you have seen it before then you may instantly recognise the food; even if you are not able to instantly remember the name you will at least remember when and where you saw it the last time. The appearance of a food includes its size, shape, colour, structure, transparency or turbidity, dullness or gloss, and degree of wholeness or damage.

The growing obesity crisis is but one of the signs that humankind is not doing such a great job in terms of optimizing the contemporary food landscape. While the blame here is often put on the global food companies – offering addictive foods, designed to hit 'the bliss point' in terms of the pleasurable ingredients (sugar, salt, fat, etc.), and the ease of access to calorie-rich foods – we wonder whether there aren't other implicit cues in our environments that might be triggering hunger more often than is perhaps good for us. Here, we take a closer look at the potential role of vision. Specifically, we question the impact that our increasing exposure to images of desirable foods via digital interfaces might be having and

ask whether it might not inadvertently be exacerbating our desire for food (what we call 'visual hunger'). For example, a decorated chocolate cake, a burger, a cheesy pizza which is visually tempting.

In society at large, there is a growing awareness of just how much people like to take pictures of the food that they have ordered in restaurants, and chefs wanting to design food in most pleasing manner. Increasingly, it would appear that people are spending more time looking at virtual images of appetizing foods, and paying less attention to the actual foods being consumed (see figure 2). Worse still, many of us eat while mindlessly watching screens (TV, or smartphone), failing to focus our attention on the flavour experience which might the very source of lower satiety, and higher-calorie food intake. The pleasure of seeing virtual food (the hunger for images, or 'digital grazing') while eating has in some sense superseded the pleasure of seeing the real thing. And while some might be tempted to see this as the fault of industry/marketers, it is important to remember, given the growing popularity of consumers taking pictures of food, that the problem here would appear to be, at least partly, self-inflicted. Excessive food photography and over exposure to pictures of food may also lead to satiation.

Figure 16. 2: Growing craze for food photography

Given the current obesity crisis, it would seem advisable to pay particular attention to any environmental factor that may influence our relation to food, and potentially sensitize the brain to food stimuli.

Smell

Foods especially when they are hot give out volatile vapours which we call aroma. Even before we eat, these vapours rise and enter our nostrils, then travel up and reach the end of the nose between the two eyes. Aromas are transmitted to a special part of the brain that houses emotions. Thus, two people - A and B may smell the same 'samosa' but A maybe transported to a time when he got scolded by the mother for finishing his own and his brother's share and B maybe transported to a lovely roadside shack in the hills of Dalhousie where he had the best samosa 10 years ago. Some aromas may be instantly recognised while others may need effort and reference.

As per scientific concepts of tasting, aroma is strictly the odour/smell which we sense before eating that is when the food is still outside your mouth. Aromas have the power to make our mouth water in anticipation of eating very tasty food. Similarly, some aromas can completely put us off like rancid food's smell and tell us that they have decomposed and thus, have become unfit for consumption.

We all know coffee has a wonderful aroma, but what do you think about cucumber? Most of us would say no or maybe. Please try this - take a normal bite of cucumber and while chewing pinch your nose for a few seconds and then release it. Most of the people would answer - yes cucumber has an aroma/odour but only inside the mouth. This is called aromatics. So, the sense of smell has 2 paths *aroma* from outside mouth and *aromatics* from the inside mouth; but they are captured by the same hair-like structure seated deep inside forehead in-between the eyes.

Food aroma/odour has been shown to influence food choices, portion selection, and can promote a specific desire to consume certain foods. Even when satiated, the sight or smell of a desirable food can stimulate appetite. People that exhibit a higher level of dietary restraint have been shown to be more responsive to food odour cues, resulting in a higher appetite and desire to consume the cued food item. Others have suggested exposure to a desirable savoury odour increases reactivity and attention to all food, leading to a general desire to eat. Frequently, these studies focus on responsiveness to energy dense, highly palatable foods such as pizza, or ice-cream. In this sense, responsiveness to energy-dense foods may be one important mechanism that promotes energy intake by stimulating appetite, by increasing the number of eating events, and types of foods selected. A similar phenomenon has been described as non-homeostatic hunger or "hedonic hunger," where susceptible individuals are more sensitive to food cues and seek food spontaneously, eating for pleasure, irrespective of any underlying need. Individual differences in appetite responsiveness to rewarding properties of the food environment can be measured using the "power of food scale," which also suggests that, for some people, food odour is a very powerful stimulus that can motivate eating in the absence of hunger, snacking, and promote positive energy balance.

Texture

This refers to those qualities of a food that can be felt with the fingers, tongue, palate, or teeth. Foods have different textures, such as crisp crackers or potato chips, crunchy celery, hard candy, tender steaks, chewy chocolate chip cookies, and creamy ice cream, to name but a few. Not only Indian food but chips are being added even to Burgers and Pizzas

to make them crunchy and crispy. This is one of the ways of introducing '*sonic seasoning*'.

Individuals have a preferred way to manipulate food in their mouths (i.e., mouth behaviour) and that this behaviour is a major driver of food choice, satisfaction, and the desire to repurchase. Texture, which is currently thought to be a major driver of product choice, is a secondary factor, and is important only in that it supports the primary driver—mouth behaviour. Currently there is a trend to include the textural properties of the product in the message, for example, crunchy, chewy, or creamy. Sometimes these words are used to connote more quality or emotional aspects such as freshness or mood, but at other times to connote texture preferences. However, with concepts that employ texture messaging, the underlying belief is that (1) these textural characteristics are of interest to most consumers: (2) these textural words are clearly understood by both marketers and product developers; and (3) products can be easily optimized using current product development and sensory tools.

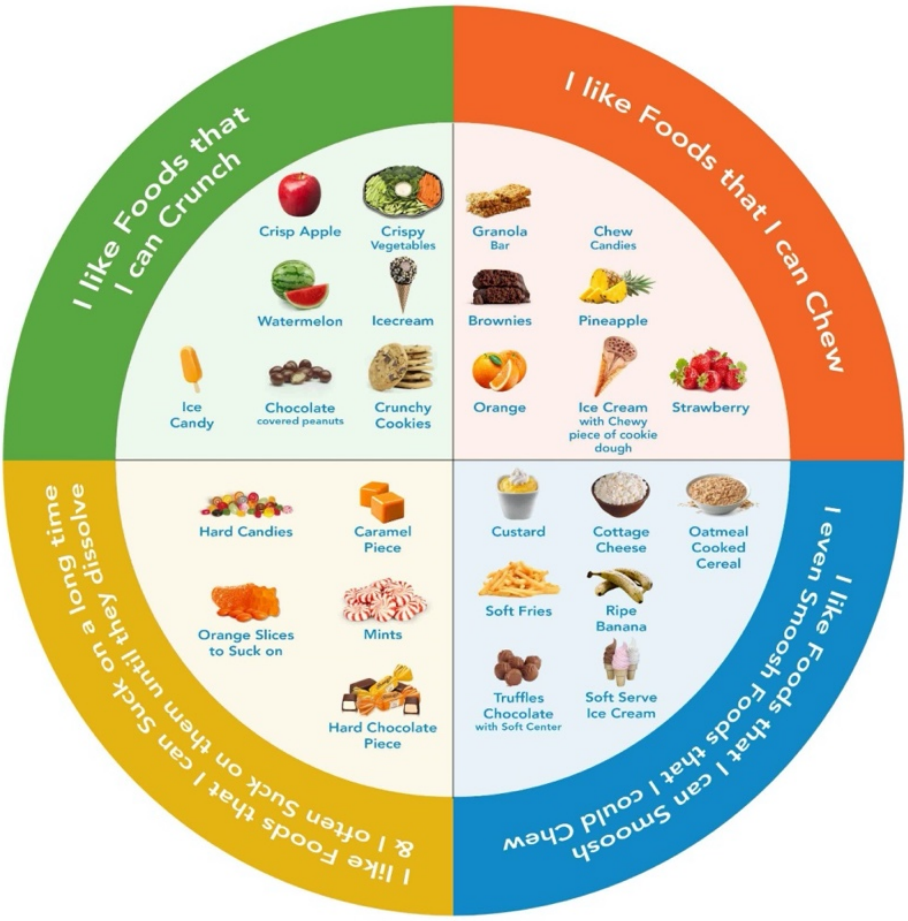

Figure 16. 3: Food textures that people like

Figure 3 describes the different textures we like in food. Texture preferences changes during various stages, for instance older individuals who have experienced dental issues indicated that they could no longer enjoy many of the foods that were preferred when they were younger. While some studies have also concluded that taste sensitivity, and chewing behaviour differ by gender.

Flavour = Taste + Aroma

Flavour is a combination of taste and smell/aroma and is largely subjective. If a person has a cold, food usually seems to be tasteless. However, it is not the taste buds that are affected but the sense of smell. People vary in their sensitivity to different tastes. Sensitivity depends on the length of time allowed to taste a substance. Sweet and salt tastes are detected quickly (in less than a second), because they are detected by taste buds on the tip of the tongue; in addition, they are usually very soluble compounds. Bitter compounds, on the other hand, may take a full second to be detected because they are detected at the back of the tongue. The taste may linger, producing a bitter aftertaste.

Sensitivity to a particular taste also depends on the concentration of the substance responsible for the taste. The threshold concentration is defined as the concentration required for identification of a particular substance. The threshold concentration may vary from person to person; some people are more sensitive to a particular taste than others and therefore are able to detect it at a lower concentration.

Let's understand this better with an example: There are 3 friends Nehmat, Ravi and Aryan. They are around 8 years old. One day they all had a glass of milk each at Nehmat's house. All three glasses of milk had the same quantity of sugar - 1 teaspoon each. Ravi found the milk to be too sweet whereas Aryan found the milk less sweet, almost bland. Nehmat was the only one who enjoyed her milk. 3 kids - same sugar - but 3 different perceptions of sweetness.

Below the threshold concentration, a substance would not be identified but may affect the perception of another taste. For example, sub-threshold salt levels increase perceived sweetness and decrease perceived acidity, whereas sub-threshold sugar concentrations make a food taste less salty than it actually is. Another debatable topic is that the flavour enhancers such as MSG (monosodium glutamate) also affect taste sensitivity by intensifying a particular taste in a food though there are no specific studies to establish this as a fact.

Temperature of a food also affects its flavour. Warm foods generally taste stronger and sweeter than cold foods. For example, melted ice cream tastes much sweeter than frozen ice cream. There are two reasons for the effects of temperature on flavour. The volatility of substances is increased at higher temperatures, and so they smell stronger. Taste bud receptivity also is an important factor. Taste buds are most receptive in the temperature range between 20-30°C, and so tastes will be more intense in this temperature range.

Psychological factors also affect taste sensitivity and perception. Judgments about flavour are often influenced by preconceived ideas based on the appearance of the food or on previous experience with a similar food. For example, strawberry flavoured foods would be expected to be red. However, if coloured green, because of the association of green foods with flavours such as lime, it would be difficult to identify the flavour as strawberry unless it was very strong. Colour intensity also affects flavour perception. A stronger colour may cause perception of a stronger flavour in a product, even if the stronger colour is simply due to the addition of more food colouring. Texture also can be misleading. A thicker product may be perceived as tasting richer or stronger simply because it is thicker and not because the thickening agent affects the flavour of the food. Other psychological factors that may come into play when making judgments about the flavour of foods include time of

day (for example, certain tastes are preferred at breakfast time), general sense of well-being, health, and previous reactions to a particular food or taste.

Taste Sensitivity: driving our food choices

We already know that there are two types of taste - basic tastes and ayurvedic tastes. Now let us learn a little about them.

Basic Tastes include- Sweet, Salty, Sour, Bitter and Umami. Western contemporary science says only these 5 can be called tastes. Do you think it does justice to our Indian food? Using these 5 tastes can we describe all the elements of your 1 portion of vegetable e.g. *aloo gobi*? Only salt and oil/fat are covered what is left out is *haldi* (turmeric), garlic, ginger, different spices and chillies. In addition to this, what is left out is that special taste that we get when we eat *jamuns, amlas*, and roasted gram (*chana*).

Whatever has been left out has always been covered under Ayurveda as tastes. *Jamuns*, roasted gram (*chana*), tea, and coffee have a unique taste where you feel your entire mouth is kind of drying out. This is called **astringency** in English and *kashaya* in Ayurveda.

Now let us look at the term - *'Mirch Masala'*. Some of us have started using just one word to describe this both - Spiciness. Do you think the sensations in your mouth when eating a single piece of clove is the same as when eating green chilli? The answer is yes to some extent. That's why '*mirchi'* and '*masala'* both are '*katu*" in Ayurveda and "*pungent*" in western science. Yet *masalas* and mirchis are not substitutable. We can distinguish between them when we are eating any cooked food.

Why can't the Ayurvedic tastes astringency and pungency be included under basic tastes? Scientifically basic tastes are those that are captured on the tongue by our taste buds and Ayurvedic tastes are not captured on the tongue but instead on the nerves in the face. Tastes that are captured by the taste buds on the tongue are basic tastes. Astringency and pungency are not captured by the taste buds on the tongue hence they cannot be considered as basic tastes.

Taste is the most important deciding factor of choice we make in food. Taste is a complex sense. In addition to sensations arising in taste receptors, it is influenced by chemical, tactile, warm, and cold receptors in the mouth, and particularly by olfactory sensations. Our inclination towards one particular taste sensitivity could lead to various health effects. For instance, a "sweet tooth" leads to obesity through excess sugar consumption, is an overly narrow theory. There are multiple links between taste perceptions, taste preferences, food preferences, and food choices and the amount of food consumed. The impact of taste factors on food intake further depends on sex and age and is modulated by obesity, eating disorders, and other pathologies of eating behaviour.

Taste is a key factor that impacts food intake. Although much research has been devoted to the study of the peripheral gustatory system and taste quality, current understanding of the specific interplay of receptor activation, signalling, and hormonal modulation remains complex. Genotypic variation results in various phenotypes of food preference and nutrient intake. Additionally, the hormonal milieu impacts food hedonics and macronutrient intake. Increased knowledge of chemosensory variation will allow insight into individual's

eating behaviour and potentially identify therapeutic targets for chronic health problems such as obesity.

Thus, it is very important that habit of choosing balance in food should be inculcated from early life as it will influence later health. Food preferences are formed in infancy, and are tracked into childhood and beyond. Good food habits in childhood are important for preventing obesity later in life. Many studies show that children prefer high-energy, sugary, and salty foods. In pre-school age they tend to reject new foods. Thus, starting from the prenatal period, a varied exposure in utero and repeated experiences with novel flavours during breastfeeding and complementary feeding increase children's willingness to try new foods and make balanced food choices.

Collectively, these data suggest that individuals with abnormal taste responsiveness (which leads to an altered perceived taste sensation evoked by foodstuffs, such as vegetables) may alter their intake of certain foods, thereby leaving them susceptible to perturbations in metabolic homeostasis. And this does indeed seem to be the case. For example, multiple investigators have shown sweet taste responsiveness to be correlated with body mass index (BMI). Moreover, the preference for consuming sugar-sweetened beverages was shown to be correlated with increased blood pressure. Bitter taste sensitivity/responsiveness has been associated with BMI, adiposity, and risk factors for cardiovascular diseases. Sensitivity to other taste qualities has also been associated with energy consumption and BMI. Thus, achieving a greater understanding of the factors that influence taste responsiveness could be potentially useful in our attempt at influencing nutritional intake and human susceptibility to diseases related to food intake patterns. Balance of all the tastes is the key to healthy diet.

It could also be noted that in some of the conditions the taste sense gets compromised and thereby affects the food choices. Abnormal taste function is present in healthy elderly people, and in patients with chronic renal failure and cancer. Smoking also decreases taste perception. In two separate population groups, a comparison of taste perception among samples of smokers and non-smokers revealed that the taste thresholds for bitter (using quinine hydrochloride) was significantly higher in smokers than in non-smokers. There was no significant difference in the taste thresholds for sweet, sour, or salt between smokers and non-smokers. Bitter is thus specifically affected. The age of the smoker, and thus presumably the duration of smoking, as well as the amount smoked, both adversely affected sensitivity to quinine solutions.

Humans use all of their senses to evaluate the sensory properties of a food. This evaluation begins before consumption and is based on how the food looks and smells; you would not choose green coloured fries or a grey coloured rice The acceptance or rejection of a given food occurs when the human brain jointly processes: (a) information obtained from observing, handling, and consuming the food in question; (b) information acquired from the surrounding social and cultural context; (c) information gained from the physiological effects (pleasure, satiety, dislike, discomfort, etc.) experienced when eating and after eating a certain food; and (d) comparison with information stored in the memory of past experiences.

One of the primary functions, or challenges, faced by the brain is to find nutritious foods and to avoid ingesting those substances that may be poisonous or otherwise harmful. While the senses of taste (gustation), smell (olfaction), and texture (touch or oral somatosensory) provide the ultimate arbiters of a food's palatability, it is the sense of vision that provides a

far more effective means of foraging, predicting which foods are likely to be safe and nutritious to consume, and generating those expectations that will constrain the consumption experience. Contemporary neuroscience demonstrates just what a powerful cue the sight of appealing food can be for the brain, especially the brain of a hungry person. Diets have changed and nutritional theories have come and gone. Human convictions about taste, however, have remained quite consistent over time; they are characterized by continuity rather than change. Thus, taste as a new science strategy could be adopted. Taste's therapeutic significance helps in choosing the right food. Healthy eating habits should be inculcated right from childhood. Child should be encouraged to choose right food. The second concept by which we can improve our diets is eating and knowing. Educate people of the calorie intake and nutritive value of foods which would encourage them to make healthy food choices. However, the most important thing to do is to ensure that healthy foods are tasty and attractive to eat!

Summary

- The key driver for eating is hunger. Other factors also influence food choices.
- Biological, economic, physical, social and psychological determinants, as well as attitudes, beliefs and knowledge about food affect food choices.
- The central nervous system is involved in controlling the balance between hunger, appetite stimulation and food intake.
- The macro-nutrients i.e. carbohydrates, proteins and fats generate satiety signals of varying strengths. Many people are unaware of what constitutes appropriate portion sizes and thus inadvertently consume excess energy.
- Taste' is consistently reported as a major influence on food behaviour. 'Taste' is the sum of all sensory stimulation that is produced by the ingestion of a food. This includes not only taste per se but also smell, appearance and texture of food.
- Familiarity is a powerful predictor of liking for food. Unfamiliar foods tend to be disliked.
- The sight, smell, texture and flavour of a food determine whether it will be selected for consumption.
- Sensitivity to a particular taste also depends on the concentration of the substance responsible for the taste. The threshold concentration is defined as the concentration required for identification of a particular substance.
- Flavour is a combination of taste and smell and is largely subjective. Temperature of a food may determine its flavour. Psychological factors also affect taste sensitivity and perception.
- Basic tastes include- Sweet, Salty, Sour, Bitter and Umami. In addition, there are taste sensations of astringency and pungency which are well documented even in Ayurveda.

Key words

Gustation – sense of taste

Kashaya – astringent

Katu – pungent

Olfaction – sense of smell

Oral-Somatosensory – sensation arising in the mouth providing information on the structure and state of object in mouth

Satiety - satisfaction of appetite

Sonic Seasoning – is a scientific field that uses sound to make food taste better

Exercises

1. List the factors that may influence food choices of individuals.
2. Discuss the pros and cons of food photography.
3. What is the difference between aroma and aromatics?
4. Explain how texture and flavour play a vital role in choosing foods.
5. What do you understand by the term 'sonic seasoning'? How will you use it to make food taste better?
6. What are basic tastes? Why are astringency and pungency not covered under these?
7. How will you use the knowledge about taste being a major determinant of food choices to encourage individuals to choose healthy foods?

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