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Food additives – their role and guidelines

Food is so vital for nutritional well-being which is essential at every stage of life. While nutritional requirements keep changing during different stages of life food preferences and food intake also keep changing. So it is a challenge to keep food acceptable across all age groups and at all times. It would be rather facetious and absurd to believe that hunger and nourishment are the only needs that have to be satisfied by food. Equally important are the sense organs (jñānendriya) which function like “gatekeepers” to our body. Food should appeal to all of them, not just the taste buds. Neuroscientists vouchsafe that olfactory system, where odour is sensed ortho-nasally and aroma retro-nasally, is an integral part in judging the food's appeal. In fact the recent findings show that the each sensory system doesn't work in isolation. Apart from appealing to the taste and smell the culinary artist will have to keep in mind that it has to appeal to the sensory organ of sight namely the eye. We also have to evaluate and distinguish the foods that are acceptable for consumption from those that should be rejected.

To satisfy all these needs the food technologists use ingredients like spices and herbs in addition to salt, sugar and certain sour and sweet juices to give unique flavour to the foods. These are called additives and its use and practice are traditional and ancient as human being's cooking habit.

The lead article in the current issue titled “Food Additives and the Health Implications” by Dr. Jagadish S. Pai looks at all parameters that are to be taken care before any additives are added to food. Their role and safety are all discussed at length and how the food industry is governed by strict rules and regulations.



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DR. JAGADISH S. PAI

Food additives and the health implications

WHAT ARE ADDITIVES?

From the times immemorial some additions have been made to the food ingredients while preparing the food in order to make it more palatable or last longer. Spices and herbs were added to give unique flavour to the foods. Salt, sugar and certain sour and sweet juices were added to give a more acceptable taste to the foods. Certain extracts from plants including fruits and vegetables have been used for better colour for foods. Salt and sugar along with juices were also used in some foods to make them last longer e.g. salt and acid for pickles, sugar and acid for jams and preserves etc. Indians add papad khar to give crispness to papads.

The natural substances have certain limitations of availability, uniformity of property, effectiveness of functionality etc. so substitutes especially the chemically prepared additives were developed. They were not only much cheaper and more abundantly available, they were very stable to conditions of usage, more effective, could give a large variety (e.g. shades obtained by colours or types of aromas by flavours etc.) and having a predictable outcome so they became quite useful to prepare a large number of food products on large scale.

With the rapid growth in application of additives, there were certain drawbacks also that came to the notice at the turn of the last century especially since the

safety testing protocols were yet to become acceptable norms. Many additives were found to be unsafe while some others were found to hide the lower quality of the products. Food & Drug Administration of the US then started standardising protocols to screen the safety of additives and today we have well laid procedures to test the safety of new additives and any other additive in use whose safety has been questioned. FDA has compiled a list of safe additives called Generally Regarded as Safe (GRAS) so these could be added to food products without limits whereas other additives have an upper limit.

Some decades ago banned colour, metanil yellow was used in India in many yellow coloured savouries and sweets like jalebi, sev, laddu, papdi to make them look brightly coloured and attractive. Concerted efforts by authority with encouragement from consumer activists have reduced its usage especially in cities but still some unscrupulous small scale manufacturers are using it. Synthetic coal tar dye amaranth was used to give red colour to food products but after its toxicity was proven, it has been banned.

WHY ARE THEY ADDED TO FOODS?

There are many types of additives that are used in foods for different applications. Each one has some role in improving one or more properties of food products. Not

all of them are equally effective and also not all are equally safe. Some of them have been considered as GRAS in the US. Many have been used in different countries for generations and have been considered as safe. Many of them are naturally present in foods and/or other materials. Following is the list of different types of additives used in foods with their examples and applications.

ACIDS: These make the foods sour and also act as preservatives since in their presence the microbes are more vulnerable. Common acids used in foods are acetic, citric, tartaric, malic, fumaric, lactic etc. all of which are naturally present in foods such as fruits and vegetables.

FLAVOURS: Early flavours were derived from natural substances like herbs and spices but as their availability and variation were limited newer flavours were prepared synthetically. Natural flavours were also analysed to identify the chemical substances that made up these natural ones and then by mixing nature identical substances the similar flavours were artificially prepared. Even new compounds were discovered that gave natural flavour notes e.g. gamma nonalactone which has coconut-like flavour.

SWEETENERS: Natural sweeteners e.g. sucrose (common sugar) and glucose are not considered additives as they are used in larger quantities. As these contribute calories and the diabetics and

weight watchers avoid them, there was a search for high intensity sweeteners preferably those that do not contribute calories. Saccharin was one of the early artificial sweeteners along with cyclamate. However, cyclamate was banned for being carcinogenic. Several new artificial sweeteners have been discovered and in India besides saccharin, others such as aspartame, sucralose, acesulfame K etc. are being used to sweeten food products for weight watchers and diabetics. Recently, a natural high intensity sweetener has been introduced in other countries like USA namely stevia but Indian authorities are yet to approve it for food products.

PRESERVATIVES: Spoilage by microbes is prevented or slowed down by preservatives like sodium benzoate, potassium metabisulphite (KMS), calcium propionate, sorbate, etc. Specific preservatives act better against specific microbes and in specific food products.

STABILISERS: Even today many natural materials like pectin, gum and agar are used as stabiliser to stabilise emulsions or thicken foods such as jams and jellies. There are also many synthetic substances used as stabilisers like carboxy methyl cellulose (CMC), modified starches etc.

EMULSIFIERS: When oil is mixed with water it separates, but in presence of emulsifiers they take longer to separate. In certain combinations, they form stable emulsion without separation. Milk is a natural emulsion and lipoproteins in it act as natural emulsifiers. Many beverages like soft drinks, ice cream, whipped topping, drinking chocolate, fat spreads etc. have emulsions prepared by emulsifiers like GMS (glyceryl mono-stearate), sodium stearoyl lactylate, etc. These emulsions have greater stability when stabilisers are also added to them.

FLAVOUR ENHANCERS: These substances enhance the existing flavours e.g. MSG (monosodium glutamate) that is present in soy sauce enhances meat and vegetable flavours. Although present in soy sauce naturally, much of it is now prepared by fermentation and is purified.

COLOURS: Although food has colours naturally sometimes people prefer attractive colours being added to foods e.g. butter has annatto added to give a yellow colour. Natural colours are carotenoids like lycopene in tomatoes, carotene in oranges and carrots, anthocyanins in grapes and berries, myoglobin in meats, chlorophyll

in green vegetables etc. Synthetic colours have greater variation of shades, higher intensity, more stable and cheaper, so they are commonly used in colouring food products. Artificial colours are mostly coal tar dyes.

There are many other classes of additives including acidity regulators, anticaking agents, antifoaming agents, antioxidants, etc. have been commonly added to food products. Due to increasing use of processed foods in the previous century, there has been a great increase in application of food additives. Although many of them are harmless, some studies have shown certain effects in small number of people.

SOME ADDITIVES MAY BE UNSAFE

Most additives are harmless and most of them are in fact natural substances. Even then many people worry about the safety of additives looking at some of the studies

that have created some doubts. There are commonly three ways in which food additives have been shown in some studies to be harmful and could cause problems healthwise. Additives can cause allergies like skin rashes, difficulty in breathing, runny nose, gastro-intestine problems etc. Tartrazine, sulphites etc. have been implicated by some studies. Both were tested thoroughly by US FDA and found that a small number of people especially asthmatic are sensitive to these additives and are advised to avoid them. However, most people have no sensitivity to these at all.

Additives can also be harmful if they exceed the Acceptable Daily Intake (ADI). Except the ones that do not have regulatory upper limits of usage in food products, those with limits have been restricted because when they are used in excess amounts they could be toxic. Nitrites for example that are used in curing of meat products can interfere with oxygen carrying





ability of red blood cells.

Some additives can cause cancer when used for long. Of course these additives are banned when proven to be so. Cyclamate, amaranth and metanil yellow have been shown to alter DNA causing serious effects like cancer and/or tumours and have been banned in most countries. There are some studies that have shown that meats containing nitrite can give rise to nitrosamines that have some potential to affect DNA. Hence some people avoid consuming cured meats which contain nitrites. However, it has also been shown that nitrites have a positive effect in meats namely they inhibit *Clostridium botulinum* bacteria in meats. These bacteria are deadly if they survive and grow in food as they produce deadly toxin that is resistant to heat processing.

Attention Deficit Hyperactivity Disorder (ADD or ADHD) is the lack of ability to focus on certain activities like studies can affect some children and among the various causes diet has also been implicated by some studies. In one study in UK, certain colours and preservatives like sodium benzoate have been linked to ADD. American Academy of Paediatrics recommends a low-additive diet for children with ADD.

There have been a lot of criticism of artificial sweeteners especially aspartame. Phenylketoneuria is a rare genetic disease in which amino acid phenylalanine is not metabolised. So any food containing phenylalanine or that amino acid containing peptides or proteins must be restricted. Since aspartame in body forms phenylalanine these people must avoid aspartame and preparations containing aspartame must declare this caution on the labels of packs.

There are some critics of food additives who feel that all the additives have some problems or others when used in food products even at the levels deemed to be safe. These critics would rather have foods without any additives. However, they fail to realise that most additives are already present in our foods in different levels and we consume them everyday even when we avoid eating food products with added food additives.

HOW ARE ADDITIVES TESTED FOR SAFETY?

Dr. Harvey Wiley, the first commissioner of US FDA, started in early last century

testing of food additives. He assisted US Congress in testing the safety of chemical preservatives then being used in foods by studying effects of a diet consisting in part of various preservatives on human volunteers including him and called Wiley's Poison Squad. His efforts supported the first American food and drug regulation Pure Food & Drug Act of 1906. Although his methods were unorthodox and would not be acceptable today to use human volunteers without first doing thorough investigations by other means, this paved the way for the scientific testing of the additives.

Surveys have shown that people are concerned about the safety of food additives. There are news items coming frequently about the dangers of additives on health while they are still being allowed by authorities to be used in food products. Thus people are confused and ask for more information. The fact is that before any new additive is being allowed in food products extensive testing is carried out on its safety. Vast literature of such testing is available and is used by government authorities before permitting them.

Scientists carry out test using first animals as well as many other chemical and biological tests are conducted to find out how these additives react in the body, how they are metabolised, if there are any by-products having any physiological effects and if the additives or by-products have any toxicity on different cells and tissues, the levels at which physiological or clinical effects are seen among other things. The animals are subjected to two types of test namely acute and chronic. In the acute tests, high single doses are given to see if there are any effects and at what level of intake. In these tests, even levels are studied at which 50% of the animals die and this amount is called LD_{50} that is the Lethal Dose at which 50% animals die. When LD_{50} is high, the additive is safer compared to when LD_{50} is low. In the chronic test, doses are given repeatedly over a period of days, months or even years to see the long term effects of the additive. There are multigeneration studies conducted to see if the additives have any effect on progeny.

After all the tests are over, the scientists observe the levels of intake when there are no deleterious effects seen on animals and giving one hundred times safety factor consider just one hundredth of the amount observed to be safe in animals

for consideration in humans. Nowadays, even before the additives are given to human volunteers, they are tested in human cell cultures so we get to know much toxicological information about the additives on humans even before we test them on humans. Once the human clinical trials are over, then the additives are ready for test marketing in products again on volunteers and finally after proving its safety it will then be approved for commercial trials after government okay.

Such rigorous testing takes several years and millions of dollars, so today it is not as easy to introduce a new additive in the market. Even after the additive has been approved in food products, its intake through various products is observed or assessed and its daily intake is estimated. This should not exceed the acceptable daily intake (ADI). In order to ensure this, various food products consumed daily need to be assessed. Considering the level at which the additive is effective for intended application and the safe amounts (ADI) the regulatory authorities permit the amounts to be added in each food product.

Even after the additives have been proven safe by above-mentioned protocols, there are some doubts that always remain for some time. Different individuals are sensitive to any effects of the additive to different extent, some being more sensitive than others. There might be different interactions of additives with different food ingredients or nutrients or other additives. Some may alter the structure or properties under different conditions of storage or environment. All these are observed by authorities and scientists during initial phase of marketing of the products containing additives. So at times some scientists publish adverse effects of the additives, and then authorities either put temporary restriction on usage or ban it to give it time to study safety aspects further. Cyclamate, the artificial sweetener and Amaranth, red colour were banned as they were shown to be carcinogenic.

USE OF ADDITIVES IN FOOD INDUSTRY

Additives are not always necessary e.g. when milk is pasteurised and packed in pouches or bottles and chilled, there are not additives in it. However, when one wants flavoured milk, then colour, flavouring materials, emulsifiers etc. may be added besides sugar. Similarly when milk based sweets are prepared, pedhas look more attractive when saffron is added. However, when consumers do not want to pay high price due to saffron, yellow colour and flavours many be added.

When fruits and vegetables are fresh, they can be eaten with great relish. However, as our cities are getting bigger and populous, the distances between farms and urban consumers greatly increase and it is difficult to provide fresh fruits and vegetables. Sometimes fruits

and vegetables are not available due to season, then preservatives play a role in making fruit and vegetable products available throughout the year. Some role is also played by processes like freezing, canning & retort pouch, aseptic technology that make the fruit and vegetable products stable without preservatives. However, large number of jams, jellies, preserves, squashes, drinks and beverages etc. use preservatives to increase their shelf life as well as may use colours, flavours, thickeners etc. to improve their appearance and texture. Bread without preservatives will last only for a day or two. With preservative calcium propionate and emulsifiers it will not only last longer but also remain soft without staling.

Speciality products like ice cream, cakes, baked goods etc. require a variety of food additives without which it would

be very difficult to prepare most of these having large variations of appearance, colour, flavour, texture, mouthfeel and of course shelf life. Instant mixes and powdered foods will remain flowable when anticaking agents are added.

Many of these additives are also added in order to maintain uniformity. When different batches of the same product from same manufacturer shows product variation in colour, flavour and texture the consumers may assume poor quality or safety being the cause, even when natural variation among the natural raw materials like tomatoes, green leafy vegetables, apples etc. may be responsible for this. When there is same red colour of tomato ketchup which does not show variation in thickness, and has same degree of sourness or sweetness consumers prefer that which can only be achieved by the use of additives.

INDIAN SCENARIO

Today, there is over 25 to 30% loss of fruits and vegetables due to spoilage in India. We have lack of infrastructure including cold chain that is partly responsible. Losses can be reduced with the use of processing and food additives. The additives used in India have been used all over the world for over several decades and have been shown to be quite safe.

There are some additives that may cause some allergic reactions in small proportion of individuals as they are sensitive to these. Yellow colour tartrazine has been shown by some studies to cause allergic reactions in certain individuals. Allergy has also been shown due to natural colorant saffron by some individuals. BHT has been shown to cause urticaria. Some of the gums like xanthan, guar and acacia, all natural substances have been shown to cause some allergic reactions. Sulphites have also been implicated in sensitive individuals to trigger asthma. MSG has been blamed for Chinese food syndrome by some. Many other studies have not been able to validate these. There is a possibility of reactions in some sensitive individuals as has been shown in tartrazine e.g. 1 or 2 among 10,000 people have shown sensitivity.

Permitted additives are safe and foods with these additives can be consumed without any health effects with the exception of a small percentage of people who are sensitive to some of them. ■





Safe food for all



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INTRODUCTION

Safety, quality and hygiene of food were receiving attention in India since time immemorial, though elsewhere in the world it has started gaining importance only in recent years. The unbroken tradition of “Madi” or religious purity, especially in connection with food preparation and its offering to God, practiced by certain segments of the population is a testimony to the “safe food” practices. Though the advent of successive invaders and colonialists had attempted to destroy the basic fabric of the food safety concepts of the society, the Vedic traditions of food safety still followed is a tribute to the solid foundations laid. The concept of consuming milk only after boiling it till the milk raises, is a good example of the awareness of possible pathogens that could be present in raw milk. Historical evidence of adulteration and the penal

clauses provided by the law maker Manu and great statesman Chanukya in his Arthashastra are classical examples to show that there was a great emphasis on food safety.

WHAT IS FOOD SAFETY?

Consumption of some foods on certain occasions could lead to ill health. The common symptoms include, stomach pain, diarrhoea and vomiting. They are commonly referred to as food poisoning. If it is mild affected persons recover within 2-3 days. In some cases hospitalization is necessary and treatment is needed. The severely affected persons may also die. Scientifically, such incidents involving two or more people are called outbreak of foodborne disease. They are caused by ingestion of foods containing either preformed toxins, often referred to as foodborne intoxications or pathogens such as bacteria, which is

generally known as foodborne infections. The food safety is concerned with acute or chronic hazards that make food injurious to the health of the consumers. Food quality refers to attributes that influence the product value to the consumers. These include negative attributes such as spoilage, adulteration, discolouration, bad odour and positive attributes such as origin, colour, flavour and texture. Food hygiene refers to all conditions and measures necessary to ensure safety and suitability of food at all stages of the food chain, from farm to the plate.

There are various hazards that are responsible for making food unsafe. A biological, chemical or physical agent in food, or the condition of food with the potential to cause an adverse health effect is classified as a food hazard. Most important are the biological hazards. These include various microorganisms such as

bacteria, moulds, parasites and viruses. Next in importance are the chemical hazards caused by various environmental contaminants such as pesticide and veterinary drug residues, mycotoxins and heavy metals. Physical hazards include pieces of stone, metal, glass etc.

FOODBORNE PATHOGENS

Foodborne pathogens are microorganisms associated with foods that are responsible for causing diseases in humans. They are the leading causes of illness and death in less developed countries killing approximately 1.8 million people annually. In developed countries foodborne pathogens are responsible for millions of cases of infectious gastrointestinal diseases each year. Infections result from ingestion of live pathogenic organisms, which multiply within the body and produce disease. The pathogenic organisms include pathogens

BACTERIA SUCH AS SALMONELLA, CLOSTRIDIUM, STAPHYLOCOCCUS, CAMPYLOBACTER, YERSINIA, LISTERIA, VIBRIO, BACILLUS, AEROMONAS, PLEISOMONAS, SHIGELLA, STREPTOCOCCUS, ESCHERICHIA ETC

PROTOZOA SUCH AS CRYPTOSPORIDIUM, ENTAMEBA, GIARDIA, TOXOPLASMA, CYCLOSPORA

TREMATODES LIKE CLONORCHIS, FASCIOLA, FASCILOPSIS, OPHISTHORCHIS

CESTODE LIKE DIPHYLLOBOTHRIUM, ECHINOCOCCUS, TAENIA

NEMATODES LIKE ANISAKIS, ASCARIS, TRICHINELLA, TRICHURIS AND

VIRUSES LIKE HEPATITIS-VIRUS, ROTA-VIRUS, AND NORWALK-VIRUS ARE ALSO CONSIDERED AS IMPORTANT FOODBORNE PATHOGENS.

During recent years, emerging pathogens such as Escherichia coli O157:H7, Listeria monocytogens,

Campylobacter jejuni have been recognized to have an important role in foodborne diseases. However, in India very little work on emerging pathogens has been carried out. Foodborne diseases are still a major global public health challenge. The investigations and control of outbreak of foodborne diseases are multidisciplinary task requiring skills in the area of clinical medicine, epidemiology, laboratory-medicine, food microbiology and chemistry. In addition communication and management of efficiently controlling food safety, and creating awareness about risks are of equal importance. Further, in India many outbreaks of foodborne diseases are poorly investigated and lessons learnt out of that experience.

The predominant clinical features depending on the pathogen include upper gastrointestinal tract symptoms like nausea, vomiting, diarrhea, sore throat and respiratory symptoms, lower gastrointestinal tract symptoms like abdominal cramps, diarrhea and general infection symptoms like fever, chills,

malaise, aches and swollen lymph nodes. The World Health Organization during 2008 had published a monograph on Foodborne disease outbreaks: Guidelines for Investigation and Control. The control measures suggested include Control of source by removing implicated foods from market through food recall, food seizures; modifying a food production or preparation process; and closing food premises or prohibiting sale or use of foods. Control of transmission through public advice as exemplified by boiling of microbiologically contaminated water or avoidance of chemically contaminated water; advice on proper preparation of foods, advice to dispose of foods and emphasizing personal hygiene measures would also serve as control measures. Exclusion of infected persons from work and school is also essential. Besides infection control precautions and protection of risk of high groups like pregnant mothers, immune-compromised individuals, persons with liver complications are essential to minimize the hazards of foodborne diseases. ■

“Next in importance are the chemical hazards caused by various environmental contaminants such as pesticide and veterinary drug residues, mycotoxins and heavy metals.



FROM THE MANAGING EDITOR

OTHER NEWER FOOD BORNE DISEASES, ITS CAUSES, THE ECONOMIC IMPACT IN HUMANS AND THE OVERALL ECONOMIC CONSEQUENCES OF IMPROPER FOOD SAFETY, QUALITY AND HYGIENE WOULD BE DISCUSSED BY THE AUTHOR IN PART 2 WHICH WILL APPEAR IN SUBSEQUENT ISSUE.



P. JAGANNIVAS
MANAGING EDITOR

Write up from Managing Editor

Many of the new readers who have started receiving the copies of In Touch from recent times might not know about the organisation that publishes the journal. As the Managing editor and the Director of 'The Foundation' I would like to

brief our readers about 'The Foundation'.

Heinz Nutrition Foundation India (HNFI) is a non-profit non-commercial registered Trust with a mission "To advance the knowledge and practice of Nutrition with the goal of ensuring the nutritional well-being of the emerging generation". Its functions

By delivering the benefits that could

accrue out of proper nutritional research which HNFI funds from time to time.

Obesity, Diabetes and other life style disorders becoming very common, the endeavour had been to focus the research funding in the areas like

- Role of nutrients like Vitamin A and PUFA on regulation of development and control of obesity
- Determine the GI of brown and minimally polished rice the use of which would decrease the diabetic risk in overweight and obese individuals (currently in progress)
- Validating the time honoured process of oil massage in LBW babies to complement their energy intake through

the oral route

By delivering the message of latest trends in the field of nutrition through newsletter and sponsoring seminars

- Publishing quarterly newsletter In Touch with original articles from Indian authors
- Sponsoring seminars like
- Workshop on micronutrients,
- Workshop on Nutrition in Medical curriculum,
- National Nutrition Policy: Essential Elements,
- First World Congress – The Fetal Origins of Adult Disease, etc

By delivering advice and counselling on nutrition on a 'one to one' basis for the needy

- Running successfully a free clinic where a leading nutritionist cum dietician offers counselling on 5 days a week
- Proposal to replicate it in multiple centres



NAMES AND DESIGNATIONS OF MEMBERS IN THE PHOTO TAKEN ON 25-10-09 (HNFI SCMS MEET)

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DR. Y. K. AMDEKAR
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OF PAEDIATRICS,
INSTITUTE OF CHILD
HEALTH, GRANT
MEDICAL COLLEGE,
MUMBAI.

Additives enrich food but may add problems

Additives are naturally present in our daily food but at different levels. In order to enhance food acceptability in terms of palatability, appearance and flavor, additives have been always used such as spices, herbs, sour or sweet juices besides sugar and salt. Additives have also been used as preservatives, stabilizers or emulsifiers. As natural substances have limitations, chemically prepared additives are developed. With such artificial additives in use, issues of safety have arisen. Additives have been blamed for toxic and allergic reactions, malignancies and autism. However additives are safe in majority population. In-Touch presents scientific view on health implications of food additives by Dr. Jagdish Pai that would enrich our understanding of hitherto misunderstood subject.