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CHEMICALS AS ADDITIVES IN FOOD PROCESSING -A REVIEW

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ABSTRACT

Food additives are edible substances added to food products to enhance their taste, color, appearance and texture. Besides improving quality, these additives are added to prevent microbial growth and increase longevity of processed food products. This review have the aim in giving the outline of common food additives and their devasting effects to our body as a public concern. "Food additive" is any substance their intended use of which results, directly or indirectly, in it's becoming a component of or otherwise affecting the characteristic of any food, and which is safe under the condition of its use. Many literature shows about the problems faced with the use of food additives.Hence in this review the effects of various additives are discussed.

KEYWORDS: Food Additives, Edible Substances, Food Processing, Devasting effects

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INTRODUCTION

Most food that comes in a packet or container contains at least some food additives[1-2]. Especially when it comes to the names and numbers of food additives, which are often completely unidentifiable and unpronounceable. Being one of the most populous countries in the world, India has been witnessing significant rise in food consumption level[3], prevalence of processed and packaged food, convenience food, alcoholic and non-alcoholic beverages, bakery items, ready-to-eat food products and cereals[4,2]. These trends are expected to drive remarkable growth in the demand for food additives in the country over the coming years[5].According to the recently published Tech Sci Research report **"**India Food Additives Market Forecast and Opportunities, 2020", the market for food additives in India is anticipated to witness double digit growth at a Compound annual growth Rate CAGR over 12% during 2015-2020[4]. Growth from the capital invested disposable income and rising urban middle class population are among the key market contributors. Due to cultural and regional diversities, food consumption pattern is very not uniform in various parts of the country. As a result, western region generates the highest demand for food additives in the country. The region is expected to continue spearheading the market due to the presence of a large number of food and beverage manufacturing companies in the states of Gujarat and Maharashtra.[6]Firmenich Aromatics India Private Limited, Zydus, Cadila, Danisco and Adani Wilmer Limited are some of the major food additives suppliers operating in India. Global food giants such as Mars, Mondelez, PepsiCo, Inc. and Kraft Foods have also been supplying their food items and are among the major food additives consumers in India[7,8].“Indian food additives market is dominated by the flavors segment due to their substantial use in beverages, savory items and cereals[9–11]. With rising incidences of health problems like diabetes, consumers are also shifting towards all-natural, low calorie sweeteners such as Stevia[12-13]. As a result, sweeteners are most likely to witness faster growth over the next five years and emerge as the leading segment in India food additives market through 2020[14-15].”

Needs of Food Additives

Additive ingredients helps to preserve and improve the taste of food for centuries and without certain additives many processed foods would be unsafe to eat, and if they weren't we wouldn't want to eat them anyway[16–18]. Some of the functions of food additives include:

- adding or restoring colour to foods (artificial colours have code numbers in 100s)
- preventing food from 'going off' (preservatives have code numbers in 200s)
- slowing or preventing the oxidative deterioration of foods (antioxidants have code numbers in 300s)
- Improving the flavour of food (food enhancers have code numbers in the 600s).

"Consumers expect certain types of food to be certain types of colour so for example, if there are no colours we'd be eating clear margarine."

Problems of Food additives

Preservatives have been associated with intolerances, particularly among people with asthma. Sulfites (including sodium bisulphite (222), sodium metabisulphite (223) and potassium bisulphite (228)) found in wine, beer and dried fruit, are known to trigger asthmatic episodes and cause migraines in people who are sensitive to them[19]. Also sodium nitrate (251) and sodium nitrite (250), which are used in processed meats, have been classified as 'probably carcinogenic to humans' by the International Agency for Research of Cancer (IARC)[20-21].Flavour enhancer monosodium glutamate (MSG) (621) is often used in Asian cooking and has been associated with 'Chinese Restaurant Syndrome' (a collection of symptoms including headache, numbness and tingling that some people experienced after eating foods containing MSG)[22–24]. While numerous studies have found MSG is safe for most of us, some people experience symptoms if they eat a large amount of MSG in a single meal[25].Food colourings, such as tartrazine (102), allura red (129) and ponceau 4R (124), are often credited as the cause of hyperactivity in children[26].

Natural additives

The distinction between 'artificial' and 'natural' food additives, is misguided because almost everyone who is sensitive to an artificial additive will also be sensitive to one or more natural substances[27-28]."Sometimes the additives and the natural substance are chemically identical, sometimes they're chemically closely related and the distinction between natural and artificial is completely artificial."Swain says the main difference between these compounds in 'natural' versus processed foods is concentration. However, she stresses that for the majority of people, the nature and levels of additives in our food supply are not an issue as long as they are consumed in moderation[29].

Commonly used chemicals as additives

Chemical food additives preserve the shelf life by reducing or eliminating the growth of microorganisms that causes food decay. These added chemicals are controversial as some may have a detrimental effect on health. Eating more fresh, whole foods may be safe alternative for use of these chemicals. The commonly used additives in food products includes[8,26]

a. Sweeteners-Aspartame, Saccharine
b. Artificial colours- Bixin, Carotene, Saffron
c. Flavours and Flavour Enhancers-MSG
d. Antioxidants- BHA & BHT
e. Preservatives- Nitrites, nitrates, Sulfites, Benzoic acid and sodium benzoate
f. Flouring agents- Potassium bromate

EFFECTS OF ADDITIVES

Sweetners- Aspartame, Saccharine

Aspartames are sweetners they add sweetness with or without the extra calories. The artificial sweetener aspartame (L-aspartyl-L-phenylalanyl-methyl ester), is consumed, primarily in beverages, causing significant elevations in plasma and brain phenylalanine levels few reports suggest that some people suffer neurologic or behavioral reactions in association with aspartame

consumption[30-31]. Since phenylalanine can be neurotoxic and can affect the synthesis of inhibitory monoamine neurotransmitters, the phenylalanine in aspartame could conceiveably mediate neurologic effects. The metabolites of aspartame include aspatate, methanol, phenylalanine and phenylketoneuria[32-33]. Strong link between intake of sugary beverages and overweight in children and the Sweetners also found to increase apetite thereby by causing weight gain in adults[34].

Artificial Colours- Bixin, Carotene, Saffron

Food coloring, or color additive, is any dye, pigment or substance that imparts color when it is added to food or drink. They come in many forms consisting of liquids, powders, gels, and pastes. Offset color loss due to exposure to light, air, temperature extremes, moisture and storage conditions; correct natural variations in color; enhance colors that occur naturally; provide color to colorless and "fun" foods[35]. These include colour stabilizers, colour fixatives, colour retention agents, etc. They consist of synthetic colours, and Natural Colours colours from . Even though colours add nothing to the nutritive value of foods, without certain colours most consumers will not feel them attractive to buy or eat some foods without colours[15]. Thus, colours are frequently added to restore the natural ones lost in food processing or to give the preparations the natural colour we expect. A number of natural food colours extracted from seeds, flowers, insects, and foods, are also used as food additives. One of the best known and most widespread red pigment is bixin, derived from the seed coat of *Bixa orellana*, the lipstick pod plant of South American origin. Bixin is not considered to be carcinogenic. The major use of this plant on a worldwide basis, however, is for the annatto dye, a yellow to red colouring material extracted from the orange red pulp of the seeds. Annatto has been used as colouring matter in butter, cheese, margarine, and other foods. Another yellow colour, a carotene derived from carrot, is used in margarine. Saffron has both flavouring and colouring properties and has been used for colouring foods. Turmeric is a spice that gives the characteristic colour of curries and some meat products and salad dressings. A natural red colour, cochineal (or carnum) obtained by extraction from the female insect (Coccus cacti), grape skin extract, and caramel, the brown colour obtained from burnt sugar, are some natural colours that are used as food additives.Food colorings may cause mental disorder of the neurodevelopmental type in childrens[36,37]. Examples Many processed foods, (candies, snack foods, margarine, cheese, soft drinks, jams/jellies, gelatins, pudding and pie fillings)

Artificial Flavouring- MSG

Add specific flavors (natural and synthetic). Flavour enhancers are not flavours themselves but they amplify the flavours of other substance through a synergistic effect[38]. Flavour and flavor enhancers constitute the largest class of food additives. Natural flavor are substances, such as spices, herbs, roots, essences, and essential oils, have been used in the past as flavor additives[39]. The flavours are in short supply and the amount of flavor substances in them is very tiny. It would take about tonne of many spices to produce 1 g of the flavor substances, and in some cases only 0.1 g can be extracted[40,41]. Natural food flavours are thus being replaced by synthetic flavor materials. The agents responsible for flavor are esters, aldehydes, ketones, alcohols, and ethers. These substances are easily synthesized and can be easily substituted for natural ones. Typical of the synthetic flavor additives are amyl acetate for banana, aldehyde, hydroxyl and ether for vanillin, methyl anthranilate for grapes, ethyl butyrate for pineapple, etc[42-43]. Generally, most synthetic flavours are mixtures of a number of different substances. For example, one imitation cherry flavor contains fifteen different esters, alcohols, and aldehydes. One of the best known, most widely used and somewhat controversial flavor enhancers is monosodium glutamate (MSG), the sodium salt of the naturally occurring amino acid glutamic acid. This is added to over 10,000 different processed foods. This has been extracted from seaweeds and soya bean[44]. MSG is found to produce attractive meat like flavor. MSG is now manufactured on a large scale all over the world, and especially in Japan. MSG is generally recognized as safe[45]. Few reports suggests for some individuals experience symptoms often comparable to those of heart attack, when served with food containing large amounts of MSG. Yeast extract has the same flavor enhancing property as MSG. It is found that, in this case, the flavor enhancing substances are the ribonucleotides. These are ten times more powerful than MSG[46]. Examples of foods rich in flavouring agents includes Pudding and pie fillings, gelatin dessert mixes, cakemixes, salad dressings, candies, soft drinks, ice cream, BBQ sauce[25]

Antioxidants- Butylated hydroxyl anisole

These are the antioxidants used in food processing. An antioxidant is a substance added to fats and fat containing substances to retard oxidation and thereby prolong their wholesomeness, palatability, and, sometimes, keeping time[47]. An antioxidant should not contribute an objectionable odour, flavor, or colour, to the fat or to the food in which it is present[48]. It should be effective in low concentrations, and be fat soluble. Also, it should not have a harmful physiological effect. Some antioxidants used in foods are butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl gallate (PG), and teriarybutyl hydroquinone (TBHQ), which are all phenolic substances. Thiodipropionic acid and dilauryl thiodipropionate are also used as food antioxidants[49]. The Joint FAO/WHO Expert Committee on Food Additives has recently considered the Acceptable Daily Intakes (ADIs) of BHA and BHT and set them at 0-0.5 mg/kg body weight for BHA and 0-0.3 mg/kg body weight for BHT. Naturally occurring substances that act as anti- oxidants are tocopherols. The tocopherols act as biological anti-oxidants in plant and animal tissues, but they are rarely used as additives because they are more expensive than synthetic anti-oxidants[50]. However when large amounts of antioxidants nutrients are taken, they can also act as pro-oxidants by inducing oxidative stress [51]

Preservatives - Benzoic acid and sodium benzoate

A preservative are any substance which is capable of inhibiting, retarding, or arresting, the growth of microorganisms, of any deterioration of food due to microorganisms, or of masking the evidence of any such

deterioration. It is estimated that nearly 1/5 of the world's food is lost by microbial spoilage[52]. Chemical preservatives interfere with the cell membrane of microorganisms, their enzymes, or their genetic mechanisms. The compounds used as preservatives include natural preservatives, such as sugar, salt, acids, etc, as well as synthetic preservative Prevent food spoilage from bacteria, molds, fungi, or yeast (antimicrobials); slow or prevent changes in color, flavor, or texture and delay rancidity (antioxidants); maintain freshness Examples- Fruit sauces and jellies, beverages, baked goods, cured meats, oils and margarines, cereals, dressings, snack foods, fruits and vegetables[53]. There are certain harmful effects of using chemicals for preservation such as ;Sulfites are common preservatives used in various fruits, may have side effects in form of headaches, palpitations, allergies, and even cancer. Nitrates and Nitrites: These additives are used as curing agents in meat products[54]. It gets converted into nitrous acid when consumed and is suspected of causing stomach cancer. Benzoates are used in foods as antimicrobial preservatives, and have been suspected to cause allergies, asthma and skin rashes. Sorbates/sorbic acid are added to foods[55] as antimicrobial preservatives. Reactions to sorbates are rare, but have included reports of urticaria and contact dermatitis[56]. Also a nuclear radiation when used for preservation does not make foods radioactive, but may cause changes in food color or texture[53,57].

Flour improvers- Potassium bromate

These are bleaching and maturing agents; usually, they both bleach and"mature" the flour. These are important in the flour milling and bread baking industries. Freshly milled flour has a yellowish tint and yields a weak dough that produces poor bread. Both the colour and baking properties improve by storing the flour for several months before making bread. Chemical agents used as flour improvers are oxidizing agents, which may participate in bleaching only, in both bleaching and dough improvement, or in dough improvement only[58]. The agent that is used only for flour bleaching is benzoyl peroxide. This does not influence the quality of dough. Materials used both for bleaching and improving are chlorine gas, chlorine dioxide, nitrosyl chloride, and nitrogen di and tetraoxides[59]. Oxidizing agents used only for dough improvement are potassium bromate, potassium iodate, Calcium iodate and calcium peroxide. Potassium bromated has been banned in food products because they are potent carcinogens[60].

Nutrient Supplements – Vitamin C

Nutrient supplements restore values lost in processing or storage, or ensure higher nutritional value than what nature may have provided. When foods are processed, there may be loss of Some nutrients and additives may be added to restore the original value. For example, to produce white flour, wheat is milled in such a way as to remove the brown coloured part of the grain, which is rich in vitamins and minerals[61]. To restore the nutritive value, thiamine, nicotinic acid, iron and calcium, are added to the flour. Similarly, vitamin C is added to canned citrus fruits to make up the loss of the vitamin during processing. The added vitamin c will increase the acidic levels in the canned citrus juice[62].

CONCLUSION

Additive chemicals are used to increase the shelf life of food and to maintain the quality and colour of the finished product for the long period of time.the chemicals that are used as additives have side effects. Hence as a consumer we have to check the label of the consumable products and know about the preservatives colouring agents and other additives added to the product and then select for consuming purpose. . Side reactions of these additives can be immediate or build up in the body over time. Thus it is always best to eat a additive free diet if at all possible as pure as organic from Nature.

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CONFLICT OF INTEREST

Conflict of interest declared none.

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