International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
VET 2016; 1(1): 01-05

www.veterinarypaper.com
Received: 01-05-2016
Accepted: 02-06-2016

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Food Additives and Their Associated Health Risks

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Abstract
In this study, we examined the various food additives and the various health risks involoved in the use of food additives. Additives include flavourings that change a food's taste, preservatives that extend its shelf life, colourings that change the way it looks, and dietary additives, such as vitamins, minerals, fatty acids and other supplements. Packaging is considered an indirect food additive and, in fact, many kinds of packaging actually add substances to the food they enclose.

Keywords: Food additives, digestive disorders, neuro disorders, food colours

Introduction
Americans spend about ninety per cent of their food budget on processed foods which unlike whole foods, have been treated in some way after being harvested or butchered. Almost all of these processed foods contain additives, substances intended to change the food in some way before it is sold to consumers. Additives include flavourings that change a food's taste, preservatives that extend its shelf life, colourings that change the way it looks, and dietary additives, such as vitamins, minerals, fatty acids and other supplements. Packaging is considered an indirect food additive and, in fact, many kinds of packaging actually add substances to the food they enclose.

What is food additives
The federal Food, Drug, and Cosmetic Act defines a food additive as**,** "any substance not being a food per se, the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food". The term includes any substance intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food; and includes any source of radiation intended for any such use

Health effect of food additives
It is often the additives that are used to give a food a marketable quality, such as colour, that most commonly cause allergic reactions. Some of these hypersensitive reactions include:
Digestive disorders – diarrhoea and colicky pains
Nervous disorders – hyperactivity, insomnia and irritability
Respiratory problems – asthma, rhinitis and sinusitis
Skin problems– hives, itching, rashes and swelling.

Key Additives to Avoid and Their Health Risks
Hydrogenated Fats—cardiovascular disease, obesity
Artificial Food Colours—allergies, asthma, hyperactivity; possible carcinogen
Nitrites and Nitrates—these substances can develop into nitrosamines in body, which can be carcinogenic

Sulfites (sulfur dioxide, metabisulfites, and others)—allergic and asthmatic reactions
Sugar and Sweeteners—obesity, dental cavities, diabetes and hypoglycaemia, increased triglycerides (blood fats) or candida (yeast)

Artificial Sweeteners (Aspartame, Acesulfame K and Saccharin)—behavioural problems, hyperactivity, allergies, and possibly carcinogenic. The government cautions against the use of any artificial sweetener by children and pregnant women. Anyone with PKU (phenylketonuria-a problem of phenylalanine, an amino acid, and metabolism) should not use aspartame (Nutrasweet).

MSG (monosodium glutamate)—common allergic and behavioral reactions, including headaches, dizziness, chest pains, depression and mood swings; also a possible neurotoxin

Preservatives (BHA, BHT, EDTA, etc.)—allergic reactions, hyperactivity, possibly cancer-causing; BHT may be toxic to the nervous system and the liver

Artificial Flavours—allergic or behavioural reactions
Refined Flour—low-nutrient calories, carbohydrate imbalances, altered insulin production
Salt (excessive)—fluid retention and blood pressure increases
Olestra (an artificial fat)—diarrhoea and digestive disturbances

Food Waxes (protective coating of produce, as in cucumbers, peppers, and apples)—may trigger allergies, can contain pesticides, fungicide sprays or animal byproducts.
Plastic packaging—Carcinogenic (vinyl chloride); immune reactions, lung shock

Types of food additives
The different types of food additive and their uses include:

- **Anti-caking agents**– stop ingredients from becoming lumpy.
- **Antioxidants** – prevent foods from oxidising, or going rancid.
- **Artificial sweeteners** – increase the sweetness.
- **Emulsifiers** – stop fats from clotting together.
- **Food acids** – maintain the right acid level.
- **Colours** – enhance or add colour.
- **Humectants** – keep foods moist.
- **Flavours** – add flavour.
- **Flavour enhancers** – increase the power of a flavour.
- **Foaming agents** – maintain uniform aeration of gases in foods.
- **Mineral salts** – enhance texture and flavour.
- **Preservatives** – stop microbes from multiplying and spoiling the food.
- **Thickeners and vegetable gums** – enhance texture and consistency.
- **Stabilisers and firming agents** – maintain even food dispersion.
- **Flour treatment** – improves baking quality.
- **Glazing agent** – improves appearance and can protect food.
- **Gelling agents** – alter the texture of foods through gel formation.
- **Propellants** – help propel food from a container.
- **Raising agents** – increase the volume of food through the use of gases.

The FDA regulates all food additives breaking them into three categories:

1. "Indirect Food Additives" include packaging materials such as paper, plastic, cardboard and glue that come into contact with food.
2. "Direct Food Additives" include preservatives, nutritional supplements, flavours and texturizers that are added to food.
3. "Colour Additives" are used to alter colour.

Flavouring agent
Are chemical formulations that mimic the flavours and smells of foods. Smell is just as important as taste to food processors, because most of a food's flavour appeal to the human brain—up —actually comes from its smell. Most processed foods rely on these additives to restore flavours that is lost in processing or create new flavours altogether. McDonald's, for example, adds "chicken flavours" to its Chicken McNuggets.
Common flavour additives such as sweeteners, fruit flavours, and butter or cheese flavours are found in both natural and artificial forms. The difference between the two depends on the source of the flavour and way it was derived. Natural flavours are often produced using just as much chemical manipulation as that used to create artificial flavours, and in some cases there is no real difference between a natural flavours and its artificial equivalent. In fact, due to impurities that result from some production processes, natural flavours can actually be more hazardous than corresponding artificial ones.

Mono-sodium glutamate
Professor Kikunae Ikeda who first isolated MSG from sea weed in Japan in 1908.Monosodium glutamate (MSG) is the sodium salt of amino acid one of the most abundant naturally occurring non-essential amino acids. In addition to being an ingredient intentionally added to foods, glutamate occurs as a natural part of proteins, including vegetable and animal proteins. These proteins, when broken down (i.e.: by cooking) release free glutamate and are themselves used as ingredients in various prepared meat products, soups, broths and gravy mixes. Industrial food manufacturers market and use MSG as a flavour enhancer because it balances, blends and rounds the total perception of other tastes.
Trade names of monosodium glutamate include Ajinomoto, Vetsin, and Ac'cent. Glutamate also imparts an unique taste called ‘umami' in food, and it was scientifically recognized as the fifth basic taste along with sweet, sour, salty and bitter.
The commercial production of monosodium glutamate was started in 1909. In the past, it was produced by hydrolysis of natural proteins, such as wheat gluten and soybean flakes. Nowadays, the production of monosodium glutamate is carried out through bacterial fermentation. The bacteria (Corynebacteriumglutamicus) are grown in a liquid medium containing sugars, molasses or starch as a fermentation substrate. The bacteria are able to produce and to excrete glutamic acid into the medium. Glutamic acid thus accumulates in the medium and is later separated by filtration, purified and converted by neutralization into monosodium glutamate. After additional purification, crystallization, and drying, a white powder of monosodium glutamate is ready to use as flavour enhancer.
Flavour enhancers other than monosodium glutamate are also used. Some of them are based on glutamate which are such as:

Mono-potassium glutamate, calcium di-glutamate, mono-ammonium glutamate, and magnesium di-glutamate.
Flavour enhancers not based on glutamate and having the same taste properties are guanylic acid, disodium guanylate, dipotassium guanylate, calcium guanylate, inosinic acid,

disodium inosinate, dipotassiuminosinate, calcium inosinate, calcium 5'-ribonucleotides, and disodium 5'-ribonucleotides.

In general, the use of MSG is not a health hazard to consumers. However, some individuals who consume MSG may exhibit an allergic-type reaction or hypersensitivity-a burning sensation, facial pressure, headache, nausea and chest pains appearing about 20 minutes after consumption and disappearing about two hours later. Such reactions have generally been reported to be temporary and not associated with severe adverse health effects. People sensitive enough to be affected are advised to avoid the use of this substance. This amino acid brings out the flavour in many foods. While that may sound like a treat for taste buds, the use of MSG allows companies to reduce the amount of real ingredients in their foods, such as chicken in chicken soup. In the 1960s, it was discovered that large amounts of MSG fed to infant mice destroyed nerve cells in the brain. After that research was publicized, public pressure forced baby-food companies to stop adding MSG to their products (it was used to make the foods taste better to parents).

MSG-intolerant people can develop

MSG symptom complex (Chinese restaurant syndrome) which is characterized by one of more of the following:

- A burning sensation in the back of the neck, forearms and chest.
- Numbness in the back of the neck, radiating to the arms and back.
- A tingling, warmth and weakness in the face, temples, upper back, neck and arms.
- Facial pressure or tightness, swelling of lips/face
- Chest pain, rapid heartbeat
- Headache, nausea, drowsiness
- Bronchospasm (difficulty breathing) in MSG-intolerant people with asthma.

Acids

Acids have important roles in the food industry. It have been used for centuries as important contributors to flavour and the acid environment they produce prevents the growth of many microorganisms. As the food industry has developed, so has the growth in production of processed foods. Many of these need the inclusion of an acidulant to give an acidic or sour taste.

Acetic acid

This is the acid found in vinegar and has a characteristic pungent smell. Acetic acid is widely used, particularly in the pickling industry. Naturally fermented vinegar has a variable pH and so acetic acid is added to this to form a pickling liquor with a specified acidity. It can also be used in confectionery goods and flavourings. Acetic acid has excellent bacteriostatic properties and hence has considerable importance as a preservative.

Only acetic acid produced naturally by fermentation can legally be called vinegar. In Britain the main carbohydrate used is usually malt and so the vinegar it produces is called Malt Vinegar. Acetic acid can also be manufactured synthetically by various methods**.** Derivatives of acetic acid are mono-chloroacetic acid, per acetic acid, dehydroacetic acid and sodium diacetate.

Citric acid

Food acid, naturally derived from citrus fruit, although

Commercial synthesis is by fermentation of molasses. It is used in food as an antioxidant as well as enhancing the effect of other antioxidants, and also as an acidity regulator. Present in virtually all plants, it was first isolated in 1784 from lemon juice, by the Swedish chemist Carl Wilhelm Scheele, and has been used as a food additive for over 100 years. Used in biscuits, canned fish, cheese and processed cheese products, infant formulas, cake and soup mixes, rye bread, soft drinks, fermented meat products Citric acid is widely used in the food industry to:

- provide sharp taste in soft drinks and sweets
- generate the optimum conditions for the formation of gels in jams, jellies, confectionary and desserts
- help give the conditions for the stabilisation of emulsions (e.g. processed cheese and dairy products)
- prevent the browning of salads
- enhance the action of antioxidants and prevent deterioration in frozen food
- act as an antioxidant in fats and oils
- preserve meat products and help modify their texture during their processing

Effects

No problem with naturally occurring citric acid. Artificially produced citric acid additive, depending on where or how it is produced with using sulphuric acid, many believe the product might still contain mould and sulphur/sulphites not filtered out completely during the production (Sulphur dioxide and other sulphites) causing asthmatic and allergic reactions. For most people sulphites are safe, but for example sensitive aspirin allergies or asthma sufferers can react very severely to sulphites. Damages tooth enamel. Most citric acid is produced from corn, manufacturers do not always take out the protein which can be hydrolysed and create MSG causing reactions in MSG-sensitive people

Lactic acid

This safe acid occurs in almost all living organisms. It inhibits spoilage in Spanish-type olives, balances the acidity in cheese-making, and adds tartness to frozen desserts, carbonated fruit-flavoured drinks, and other foods.

Lactic acid is widely used in the production of boiled sweets, pickled foods and as a raw material in the manufacture of important emulsifiers for the baking industry. It is produced during anaerobic respiration and is commonly manufactured by a fermentation process, although it can be produced synthetically.

It can be used as additive of food or feed to improve taste and increase shelf life, including canned food, bread, flour, cake, and feed industry. It also can be used as flavouring agent of food to adjust sour taste of solid and powdery food. Besides, it also can increase shelf life of food.

Propionic acid

Propionic acid occurs naturally in fermented food. Commercially it is chemically produced from ethylene, carbon monoxide, natural gas, fermented wood or from propion-aldehyde. Propionic acid and its propionate salts (sodium, calcium and potassium) are the main preservatives in breads, bakery goods, and flour products. They are also anti-microbial substance that kills or inhibits the growth of microbes such as viruses, bacteria, fungi and protozoans agents against bacteria, fungi predominately against moulds

Antimicrobials agent

Antimicrobials are most often used with other preservation techniques, such as refrigeration, in order to inhibit the

growth of spoilage and pathogenic microorganisms. Sodium chloride (NaCl), or common salt, is probably the oldest known antimicrobial agent. Organic acids, including acetic, benzoic, propionic, and sorbic acids, are used against microorganisms in products with a low pH. Nitrates and nitrites are used to inhibit the bacterium Clostridium botulinum in cured meat products (e.g., ham and bacon). Sulfur dioxide and sulfites are used to control the growth of spoilage microorganisms in dried fruits, fruit juices, and wines. Nisin and natamycin are preservatives produced by microorganisms. Nisin inhibits the growth of some bacteria while natamycin is active against molds and yeasts

Antimicrobials and their ADI

Antimicrobials substances	Acceptable daily intake (ADI) for man (mg/kg bw)
Acetic acid and its potassium and sodium salts	Not limited
Benzoic acid and its potassium and sodium salts	0-5
Propionic acid and its calcium, potassium, and sodium salts	Not limited
Di-ethyl pyrocarbonate	Not to be use
Sorbic acid and its sodium potassium and calcium salts	0-25
Sulphur dioxide and sulphides (sodium and potassium meta-bisulphides, sodium sulphide, sodium hydrogen sulphide)	0-0.7
Ethyl, propyl, methyl Hydroxybenzoate	0-10

Sorbic acid

Occurs naturally in fruit, used as a preservative it inhibits fungal growth but allows for bacterial activity, hence is useful for cheese. Obtained from the berries of mountain ash or synthesised from ketene; possible skin irritant, and may cause rashes, asthma and hyperactivity. Sorbic acid is used in conjunction with sulphur dioxide in wine making, without SO2 bacteria cause reduction of sorbic acid to sorbyl alcohol which converts to a foul smelling ether. Also used as a preservative in cosmetics and pharmaceuticals. Sorbic acid had a conjugated system of double bonds which makes it susceptible to nucleophilic attack, sometimes giving mutagenic products. Food labelled as containing sorbic acid may actually contain sodium, potassium or calcium sorbateinstead. Typical products include wine, cheese, other fermented products, desert sauces and fillings, soups, sweets, drinks, yeast goods.

(i) **Sodium sorbate:** Sodium sorbate is the sodium salt of sorbic acid. Typical products include wine, cheese, other fermented products, desert sauces and fillings, soups, sweets.

(ii) **Potassium sorbate**: potassium sorbate is the potassium salt ofsorbic acid. More soluble than sorbic acid. Typical products include cheese, butter, yogurt, preserves, pickles, dried fruit, cakes and wine.

(iii) **Calcium sorbate:** the calcium salt of sorbic acid. An antifungal antibacterial preservative. Typical products include fermented dairy produce, wine.

Benzoic acid

Manufacturers have used sodium benzoate (and its close relative benzoic acid) for a century to prevent the growth of microorganisms in acidic foods. The substances occur naturally in many plants and animals. Obtained from Benzoin, a resin exuded by trees native to Asia.

Benzoic acid is also used in the manufacture of plasticisers, resin coatings and caprolactam. It is an antiseptic, antifungal, antipyretic agent, and can be used as an alkalimetric standard. Added to alcoholic beverages, baked goods, cheeses, gum, condiments, frozen dairy, relishes, soft sweets, cordials and sugar substitutes. They appear to be safe for most people, though they cause hives, asthma, or other allergic reactions in sensitive individuals. Also reputed to cause neurological disorders and to react with sulphur bisulphite shown to provoke hyperactivity in children and can cause asthma in those dependant on steroid asthma medications.

(i) **Sodium benzoate:** The sodium salt of benzoic acid, sodium benzoate fulfils an antibacterial and antifungal role, and to disguise taste, as of poor-quality food; orange diet soft drinks contain a high amount of it, up to 25mg per 250ml; also in milk and meat products, relishes and condiments, baked goods and lollies, tooth pastes, mouth washes, maple syrup and margarine; used in many oral medications including Actifed, Phenergan and Tylenol

Effects

Is known to causes nettle rash and aggravate asthma. Suspected to be a neurotoxic hazard. Another problem occurs when sodium benzoate is used in beverages that also contain ascorbic acid (vitamin C). The two substances, in an acidic solution, can react together to form small amounts of benzene, a chemical that causes leukemia and other cancers. Though the amounts of benzene that form are small, leading to only a very small risk of cancer, there is no need for consumers to experience any risk. In the early 1990s the FDA had urged companies not to use benzoate in products that also contain ascorbic acid, but in the 2000s companies were still using that combination. A lawsuit filed in 2006 by private attorneys ultimately forced Coca-Cola, PepsiCo, and other soft-drink makers in the U.S. to reformulate affected beverages, typically fruit-flavoured products.

(i) **Potassium benzoate:** The potassium salt of benzoic acid, potassium benzoate fulfils an antibacterial and antifungal role. Typical products include margarine, pickles, fruit juice. People with a history of allergies may show allergic reactions.

(ii) **Calcium benzoate:** The calcium salt of benzoic acid, calcium benzoate fulfils an antibacterial and antifungal role. Typical products include fruit juice.

Paraben

(i) **Propyl-paraben:** synthesised from benzoic acid. Antimicrobial, may be a numbing effect on the mouth. Typical products include beer, fruit sauces, pickles and preserves, fruit desserts, fruit squashes and juices, processed fish. Preservative. Possible contact allergen when used in cosmetics.

(ii) **Methylparaben**: Preservative. Possible contact allergen.

Sulphides/ Sulphur dioxide

Bleaching agent, preservatives: Dried fruit, processed potatoes, juices, shrimp, wine. Sulfiting agents prevent discoloration (in dried fruit, some freshshrimp, and some dried, fried, or frozen potatoes) and bacterial growth (in wine). Sulfites can cause severe reactions in sensitive people, especially those with asthma. They also destroys vitamin B1 (thiamine), and should be avoided by anyone suffering from conjunctivitis, bronchitis, emphysema, bronchial asthma, or cardiovascular disease

(i) **Sodium sulphide:** The sodium salt of sulphurous acid. Used to sterilise fermentation equipment and food containers, as well as for its antimicrobial properties. Generally meat, cereals and dairy products may not be treated as it destroys thiamine content. Over exposure to sulphites in food may cause an asthmatic attack, or cause gastric irritation. Typical products include fresh fruit and vegetables, beer, wine, fruit juices and sauces, frozen shellfish.

(ii) **Sodium hydrogen sulphite:** Another sodium salt of sulphurous acid, sulphur dioxide may be released from food containing sulphites. May induce an attack in asthmatics, or cause gastric irritation due to this release of sulphur dioxide. Thiamine is destroyed by sulphites. Sulphites are also used as bleaching agents. Typical products include beer, wine, cider, fruit squashes and juice, fresh fruit and vegetables, frozen shellfish, jams, pickles.

(iii) **Sodium meta-bisulphite:** Another sodium salt of sulphurous acid. Used as an antimicrobial preservative, antioxidant and bleaching agent in food. Typical products include preserved fruit and vegetables, pickles, fruit juice, frozen vegetables, frozen shellfish, dried fruits, fruit desserts.

(iv) **Potassium meta-bisulphide:** A potassium salt of sulphurous acid. Used as an antimicrobial preservative, particularly in wine. Typical products include wine, frozen vegetables, fruit juice, fruit preserves, pickles, frozen shellfish.

(v) **Calcium sulphide:** A calcium salt of sulphurous acid. Used not only as a preservative but also as a firming agent and disinfectant. Typical products include wine, fruit juice, canned fruit and vegetables, fruit pickles and preserves. Avoid it. Banned in Australia.

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