Antioxidants

The truth about BHA, BHT, TBHQ and other antioxidants used as food additives

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Welcome

The aim of this book is to present you with information on one set of food additives currently widely in use - antioxidants.

It is my intention to produce a series of these books dealing with the various categories of food additives. You can find out more on the Food Can Make You Ill website (www.foodcanmakeyouill.co.uk).

Food additives serve many purposes including

- preserving food,
- improving its texture,
- enhancing or improving the flavour,
- improving its appearance, and
- prolonging its shelf life.

To provide the variety and range of food products currently on our supermarket shelves, food manufacturers need to use food additives. Without additives, only the basic food staples – meat, fruit, vegetables, and grains would be available in their unprocessed forms.

Concerns raised by consumers about food additives are sometimes seen, by food manufacturers, as a form of ignorance. If only we understood more about how additives are produced and tested and how our bodies are able to metabolize and detoxify the myriad of food constituents we are exposed to daily then we would have no grounds for our worries.[31] We really are being a little silly but are we?

Food additives, with a very few exceptions, are not substances we would ordinarily add to our food and food is a complex enough product before anything synthetic is added to it. Our bodies will do the best they can to keep us going regardless of what we eat but that does not mean that we will experience good health.

There exists a vast body of research indicating that exposure to most dietary food additives, at levels typically found in food, poses no hazard for the general population. However, as Borzelleca points out, considering the population's biological diversity, it would not be surprising if some individuals were susceptible to certain food additives.

> He goes on to note that "a nearly infinite number of synergistic or antagonistic interactions are possible between food additives, other dietary components and pharmaceuticals".[3]

It is impossible for anyone to test for all of these permutations and even if it was we could never hope to retain all this information when we do our shopping.

So, we are placed in a situation of having to accept that the regulations our governments have put in place are adequate enough to protect us. In most cases, hopefully, they are but for some of us they are not enough and we experience health problems that may never be diagnosed correctly.

Very few doctors will consider even food intolerance as a cause of health problems let alone food additives so it is likely that there are many people suffering with an array of symptoms that no doctor has been able to treat simply because they have not looked for the cause in the right place.

I do not believe food additives are intrinsically harmful and am certainly not on any crusade to have them banned. What does concern me is that we, as consumers, generally, know very little about them and the reality is that some food additives do cause harm to some people yet they are rarely investigated as the cause of health problems.

My purpose within these books is to provide you with information on just what these additives are, how they are used, and how they may cause health problems for some of us.

Please be aware that the legislation referred to in this book, unless otherwise stated, is that of the EU.

I have included references to all major sources of information used. The majority of studies that have been carried out on the safety of food additives are animal studies – I do mention these (it is hard to write this type book and totally exclude them) but I have either only read an abstract or a summary in a research paper that cites them. Ethical considerations aside, I am unconvinced by the direct relevance of animal studies to humans. Also, the evidence within them, because it is not directly transferable to humans, is open to various forms of interpretation so no definitive conclusion can ever be reached.

Important Information

Your health is the most precious resource you have – cherish and nurture it.

If reading this book raises any concerns for you about your health please consult your doctor. Any proposed changes to your diet should also be discussed with your doctor and under absolutely NO circumstances should you stop taking any form of prescribed medication without the consent of the medical practitioner who prescribed it.

It is my hope that you will find the information in this book useful and helpful but the responsibility for what you do w ith the information you read is completely your own.

Sharla Race

Definitions

ADI: stands for “Acceptable Daily Intake”. This is an estimate of the amount of a substance in food or drinking water, expressed on a body-weight basis, that can be ingested daily over a lifetime without appreciable risk (the standard human is calculated at 60kg). The ADI is listed in units of mg per kg of body weight.

Not all additives have an ADI as they are deemed to be of no risk if used within standard food manufacturing guidelines. A level of quantum satis (QS) is set. QS means that additives shall be used in the food concerned in accordance with good manufacturing practice. This means that an additive must not be used at a level higher than is necessary to achieve the intended purpose and must not be used in a way that misleads the consumer.

Antioxidant: a substance which prolongs the shelf life of foodstuffs by protecting them against deterioration caused by oxidation, such as fat rancidity and colour changes.

Compound Ingredients: ingredients of a food which are themselves made up of two or more ingredients (e.g. mayonnaise, salami, custard, seasoning). A list of ingredients within the compound ingredient is usually shown in brackets; for example, Mayonnaise (egg, water, oil, vinegar, mustard, salt).

Food additive: a substance added intentionally to foodstuffs to perform certain technological functions, for example to colour, to sweeten or to preserve.

Food additives are defined in EU legislation as "any substance not normally consumed as a food in itself and not normally used as a characteristic ingredient of food whether or not it has nutritive value, the intentional addition of which to food for a technological purpose in the manufacture, processing, preparation, treatment, packaging, transport or storage of such food results, or may be reasonably expected to result, in it or its by-products becoming directly or indirectly a component of such foods."[2]

Ingredient: any substance, including any additive and any constituent of a compound ingredient, which is used in the preparation of a food and which is still present in the finished product, even if in an altered form.

Ingredients List: the ingredients used in the manufacture of a food are listed in descending order of weight at the time of their use in the preparation of the food. If any of the ingredients make up less than 2% of the product they do not have to be listed in weight order but have to be declared by use of the term “also contains”.

Processing Aid: a substance that is intentionally used for the processing of raw materials, foods or ingredients to fulfil a certain technological purpose during processing. A processing aid would not be consumed as a food ingredient itself.

Introduction

Antioxidants occur naturally in many foods and are essential for our health. They include Vitamin C found in fruit and vegetables and vitamin E found in seeds and nuts.

Antioxidants, both natural and synthetic, are used by the food industry as food additives to help prolong the shelf life and appearance of many foodstuffs. This book is concerned with this type of antioxidant.

Foods that contain vegetable or animal fat go rancid when exposed to oxygen, heat, moisture or the action of enzymes. The speed at which this takes place depends on a number of factors including the source of the oil or fat and how it is stored. Most vegetable oils contain naturally occurring antioxidants such as vitamin E (E306).

The process of food manufacturing that brings products such as oils, margarines, chips, packaged cereals, roasted nuts, chewing gum, and r eady meals to our shops often requires the addition of antioxidants to prolong their shelf life, make them look better and stop them spoiling. The majority of antioxidants used in this way are synthetically manufactured.

If we only bought our food fresh and in its natural state there would be little, if any, need for added antioxidants but in the twenty first century most of our food reaches us after being treated or processed in some way.

There are currently six ‘groups’ of antioxidants used as food additives. These are:

BHA, BHT, TBHQ (E319-E321)
Gallates (E310-E312)
Erythorbic Acid (E315-316)
4-Hexylresorcinol (E586)
Tocopherols (E306-E309)
Ascorbic Acid (E300-E302)

The antioxidants that have caused health problems, for some people, are primarily synthetic. The most problematic antioxidants appear to be BHA, BHT and TBHQ, with gallates in second place.

The following pages give details of each of the antioxidants, the foods they are found in and the problems, if any, which have been linked with them.

Part 1

The Antioxidants

BHA, BHT, and TBHQ

BHA and BHT have been used in food products, with some restrictions, since the late 1950s. TBHQ is a more recent addition to the list of antioxidants allowed in food, in Europe, it became an accepted antioxidant for food use in 2004.

Their full names are:

BHA: Butylated hydroxyanisole (E320)
BHT: Butylated hydroxytoluene (E321)
TBHQ: Tertiary-butyl hydroquinone (E319)

There is nothing 'natural' about BHA, BHT, and TBHQ. They are synthetic compounds produced in laboratories. BHT was initially developed as an antioxidant for use with petroleum and rubber products.

All three are used as antioxidants in a large number of foods that contain oil and fat. The use of BHT has declined whilst the use of BHA has increased; this is primarily because BHA is more stable at higher temperatures. TBHQ is now appearing more and more in the products that we eat but, at the moment, BHA is still the most commonly used one of these three.

Most countries have ADIs for these antioxidants with restrictions on the amount that can be used in food products. Because of their widespread use in foods it is difficult to establish whether the ADI is being exceeded by certain sections of society; children with their liking of snack foods are of particular concern.

> In 2004, the EU decided TBHQ was non carcinogenic to humans. Their decision was based on evidence from studies with dogs, rats and mice. There remained some concern that the ADI of 0 to 0.7 mg/kg body weight may be exceeded in some cases. As always, a middle ground approach was taken: "Considering that not all fat intake in high fat eaters will come from refined oils, conservative intake estimates suggest that exposure in adults and children who are high fat eaters would not exceed the ADI."[9]

Most reviews of the scientific studies acknowledge that there may be so me problems with them but that the benefits, to us as consumers, outweigh the small potential of risks.

Foods containing BHA, BHT, TBHQ

BHA, BHT, and TBHQ are used in a variety of products but are most commonly found in foods that contain oil and fat. Their action is similar to that of Vitamin E which is used in some of the same type of products as an alternative antioxidant.

A list of some of the foods that they can be found in appears below but please be aware that it is impossible to provide a complete list – any food that contains oil or fat may also contain one of these antioxidants. BHA, BHT, and TBHQ may also have been used as processing aids or incorporated into food packaging and whilst regulations exist to minimize their impact on actual food products there is always some degree of migration into the food (see the section on Hidden Antioxidants).

Table 1: Foods that may contain BHA, BHT, and TBHQ

Active dry yeast	Flavourings other than essential oils
Cake mixes	Frying oil and frying fat excluding olive pomace oil
Cereal based snack foods	Glazed fruit
Chewing gum	Lard, fish oil, beef, poultry and sheep fat
Defoaming agents for beet sugar and yeast	Milk powder for vending machines
Dehydrated meat	Pre cooked cereals
Dehydrated potatoes: potato flakes, mashed potato	Processed nuts
Dehydrated soups and broths	Ready Meals
Dry mixes for beverages and deserts	Sauces
Emulsion stabilisers for shortenings	Sausage, poultry and meat products
Essential oils	Seasonings and condiments
Fats and oils for the professional manufacture of heat treated foodstuffs	Snack Foods

BHA and BHT sometimes appear alone in a food but are often used in combination with other chemicals that also have an antioxidant activity including propyl gallate (E310), citric acid, phosphoric acid, and ascorbic acid (E300).[55]

> "In animal fats and shortenings, if used alone BHA is less effective than BHT or the gallates, but its effectiveness increases with the addition of synergists" such as citric acid, phosphoric acid, lecithin and methione. For example, in margarine a mixture of 0.01% BHA + 0.05% dodecyl gallate is more effective than BHA alone.[35]

TBHQ is used as an antioxidant either alone or in combination with BHA and/or BHT. It is seen as being especially effective for highly unsaturated vegetable oils and many animal fats and has the advantage over some of the other antioxidants by being able to extend the storage stability of vegetable oils.

It is likely that we will see an increase in the use of TBHQ as it has been found to be particularly effective when added during the frying process leading to a longer shelf life for the product as TBHQ 'carries through' the fried product.

Whilst similar to BHA and BHT it has been found to be more effective as an antioxidant in some instances so its use in food products is on the increase. Uses are similar to those of BHA. Maldhavi[35] tells us that it is more effective in rendered poultry fat than the other antioxidants and is also more effective in "stabilizing the highly unsaturated mackerel skin lipids." It is also especially effective in cottonseed, soybean and safflower oils; is highly effective when combined with propyl gallate in peanut oil; more successful in crude, refined, bleached and deodorised palm olein. It has been combined with tocopherols in margarine and found to be very useful in fried products such as chips, deep fried instant noodles, fish crackers, tapioca chips, banana chips.

Non Food Uses of BHA, BHT, and TBHQ

BHA, BHT, and TBHQ are used in a wide range of 'non food' products that we come into contact with each day including cosmetics, toiletries and medicines. The information below relates primarily to BHA and BHT as they have been in use for much longer than TBHQ.

> A 1981 FDA survey found BHA used in 3,217 to 21,279 cosmetic formulations (goodness knows what the current figure would be). Lipsticks were the most common product for containing BHA, followed by eye shadows.

Table 2: Non food uses of BHA, BHT, and TBHQ

Animal feed	Paperboard
Anti fungal powder	Petroleum products
Cosmetics	Plastic
Dietary supplements	Plastics and elastomers
Electrical transformer oils	Polyethylene
Embalming fluid	Polyethylene food wraps
Food packaging	Resins
Ground vehicle and aviation fuels	Rubber
Laquers	Synthetic and natural rubbers
Lubricating, turbine and insulation oils	Varnishes
Medicines	Waxed paper
Nicotine patches	Waxes
Paints	

Synthetic antioxidants are frequently found in animal feed and not just as antioxidants. For example, some people think that BHT protects against aflatoxicosis in turkeys and so it is added to their food.[32] The insanity of this is that the only reason aflatoxicosis occurs is because of contaminated food in the first place.

Gallates

The gallates used as food additives are:

E310 Propyl gallate
E311 Octyl gallate
E312 Dodecyl gallate

Propyl gallate (E310) is the propyl ester of gallic acid. It can be produced from tannins extracted from nut galls or by hydrolysing the enzyme tannase. 'Galls', in case you are interested, are abnormal growths formed in response to the presence of insect larvae, mites, or fungi on plants and trees.

Octyl gallate (E311) and Dodecyl gallate (E312) are esters of gallic acid produced in similar ways to propyl gallate. Their uses and potential problems are also the same.

Their main uses are as antioxidants in foods, creams, lotions and packaging materials. All three have ADIs.

Table 3: Foods that may contain gallates

Cake mixes	Fats and oils for the professional manufacture of heat treated foodstuffs
Candy	Flavourings other than essential oils
Cereal based snack foods	Frying oil and frying fat excluding olive pomace oil
Chewing gum	Lard, fish oil, beef, poultry and sheep fat
Dehydrated meat	Milk powder for vending machines
Dehydrated potatos	Pre cooked cereals
Dehydrated soups and broths	Processed nuts
Enriched rice	Sauces
Essential oils	Seasonings and condiments

Gallates may also be used as processing aids or incorporated into food packaging and whilst regulations exist to minimize their impact on actual food products there is always some degree of migration into the food (see the section on Hidden Antioxidants).

Non Food Uses of Gallates

The main categories of non-food products that contain gallates are:

- animal feeds such as fish meal in poultry feed;
- cosmetics including lipsticks and eye shadows;
- food packaging materials.

Erythorbic acid (E315) and Sodium erythorbate (E316)

Erythorbic acid (also known as Isoascorbic acid) is a stereoisomer of ascorbic acid (vitamin C). It is readily absorbed and metabolized.

Sodium erythorbate is the sodium salt of erythorbic acid. It is an epimer (structural mirror image) of sodium ascorbate and is identical in antioxidant effect. One method of production is by the fermentation of corn sugar.

Foods that they are found in:

- cured meat products and processed meat products including hot dogs;
- preserved and semi preserved fish products;
- frozen and deep frozen fish with red skins.

Sodium erythorbate may be used to preserve freshness in fruit and vegetables. It does this by preventing discoloration and the development of 'off-flavours'. Fruit and vegetables can be protected by spraying or dipping them in an aqueous solution of sodium erythorbate (as far as I am aware this use is not allowed in the EU at the time of writing).

The most common methods of incorporating the antioxidant in fish tissue are: dipping, glazing, injection and spraying.

The industrial utilization of sodium erythorbate is increasing because of its recognized safety and environmental friendliness. It is sometimes used as an additive for boiler water because it is seen as being non-toxic, an oxygen scavenger, reducing and passivation agent. Its use helps prevent the formation and precipitation of ferric compounds by reducing the ferric ion to the ferrous state, so inhibiting corrosion.

Industrially, it is sometimes used as a reducing agent. For instance, it has been used as a developing agent in fluids used for photographic processing.

4-Hexylresorcinol (E586)

A synthetic antioxidant used as a processing aid to prevent the development of melanosis (black spot) in shrimps, lobsters and related crustacean.

The foods that it may be found in are:

Fresh, frozen and deep frozen crustaceans

There have been studies to see if it helps with the reduction of browning in fresh cut fruit but, in the EU, it is not approved for this use.

Non-food products that may include 4-hexylresorcinol include:

- Mouth washes
- Skin wound cleaners
- Soaps
- Handwashes
- Throat lozenges

Tocopherols

Tocopherols are better known as Vitamin E. They are naturally found in plant tissues especially in nuts, vegetable oils, fruits and vegetables. Some rich sources are wheat germ, corn, sunflower seed, rapeseed, soybean oil, alfalfa and lettuce.

There are four additives in this group:

E306 Tocopherols
E307 Alpha-tocopherol
E308 Gamma-tocopherol
E309 Delta-tocopherol

E306 Tocopherols
For use as food additives, they are obtained by the vacuum distillation of edible vegetable oils. Sources could include soya bean, wheat germ and corn (maize).
"They are relatively weak antioxidants compared to the synthetic phenolic antioxidants and have limited carry through properties."[35]

E307 Alpha-tocopherol, E308 Gamma-tocopherol, E309 Delta-tocopherol
These three antioxidants are all a f orm of vitamin E produced by chemical synthesis.

All the above antioxidants are generally permitted for use in foodstuffs and they do not have ADIs assigned to them.

The foods they are found in are:

- non emulsified oils and fats of animal or vegetable origin (except virgin oils and olive oil).;
- refined olive oil (E307);
- foods containing these oils.

Ascorbic Acid

Ascorbic acid is better known as Vitamin C. There are four food additives that derive from it. They are:

E300 Ascorbic acid
E301 Sodium ascorbate
E302 Calcium ascorbate
E304 Fatty acid esters of ascorbic acid

E300 Ascorbic acid
Ascorbic acid occurs naturally in many fruit and vegetables and can also be manufactured synthetically.

E301 Sodium ascorbate
Sodium ascorbate is the sodium salt of ascorbic acid (E300) and it is prepared synthetically.

E302 Calcium ascorbate
Calcium ascorbate is manufactured from ascorbic acid (E300) and calcium carbonate (E170).

E304 Fatty acid esters of ascorbic acid
“Fatty acid esters of ascorbic acid” are also known as “ascorbyl palmitate” and are produced synthetically. This antioxidant performs the same function as vitamin C (E300) but has the advantage of being fat soluble at high temperatures.

All the above antioxidants are generally permitted for use in foodstuffs and they do not have ADIs assigned to them.

Table 4: Foods that may contain E300-E304

Beer	Gehakt
Bread prepared with wheat flour, water, yeast or leaven and salt.	Jams + Jellies
Canned and bottled fruit and vegetables	Partially dehydrated and dehydrated milk
Foods designed for babies and young children	Pate
Fresh pasta	Pre packed preparations of minced meat
Fruit compote	Processed meat products (especially E301).
Fruit juices and nectars	

Part 2

Health Concerns

Health Concerns: Introduction

The **good news** is that the following antioxidants are generally seen as being safe for human use and there are virtually no reports of adverse reactions:

E300 Ascorbic acid
E301 Sodium ascorbate
E302 Calcium ascorbate
E304 Fatty acid esters of ascorbic acid
E306 Tocopherols
E307 Alpha-tocopherol
E308 Gamma-tocopherol
E309 Delta-tocopherol
E315 Erythorbic acid
E316 Sodium erythorbate

Calcium ascorbate (E302) is generally regarded as safe for human use but Hanssen notes that "it should, perhaps, be avoided by those with a predisposition to kidney stones". [23] The reason for this is that the use of calcium ascorbate may increase the formation of calcium oxalate in the urine but the amount likely to be ingested is so small that, except, in a very small number of people, it should cause no problem.

Some trials have shown that sodium ascorbate (E301) increases the adverse effects of known carcinogens in rats. [23] There have been no studies on humans.

In the UK, the only antioxidants allowed in food for babies and very young children are E300 through to E309.

The **bad news** is that health concerns and/or adverse reactions have been identified with the additives listed below:

E319 TBHQ (Tertiary-butyl hydroquinone)
E320 BHA (Butylated hydroxyanisole)
E321 BHT (Butylated hydroxytoluene)

E310 Propyl gallate
E311 Octyl gallate
E312 Dodecyl gallate

The remainder of this section deals with these two groups of food additives.

The antioxidant not mentioned in the lists above is **4-Hexylresorcinol (E586)**. Little information is available possibly because, as a food additive, it is a relative newcomer and because its food uses, at the moment, are very limited. What we do know is that it has caused contact dermatitis in humans.[5] Winter notes that 4-Hexylresorcinol "can cause severe gastrointestinal irritation; bowel, liver, and heart damage has been reported. Concentrated solutions can cause burns on the skin and mucous membranes".[58] Animal studies have included one that found a dose of 260 mg/kg bw was lethal to all animals, at lower levels there was some tumour growths and cancer in certain animals.[24]

BHA, BHT, TBHQ

Whilst the majority of studies have been carried out on animals, there is still quite a large body of research that has identified problems with these synthetic antioxidants for humans. The table below lists some of the health problems in humans that have been linked with adverse reactions to BHA, BHT and/or TBHQ.

Table 5: Adverse reactions to BHA, BHT and/or TBHQ.

ADHD	Joint pains
Allergy	Rhinitis
Angioedema	Sleepiness
Asthma	Stomach problems
Dermatitis	Undescended testes
Excessive sweating	Urticaria
Eye problems	Vasculitis
Flushing	Weight gain
Headache	

General

One study reported on seven individuals with reactions to BHA and BHT. Their symptoms included vasomotor rhinitis, headache, flushing, asthma, conjunctival suffusion, dull retrosternal (behind the breastbone) pain radiating to the back, diaphoresis (excessive sweating), or somnolence (sleepiness). In a later study, identifying cross reactivity with aspirin, they found twenty-one people intolerant to BHA and BHT.[15,16]

“Some people are allergic to BHA; one study in 1977 suggested that there may be an imbalance in their body’s fat metabolism.”[23]

In respect of TBHQ, Winter writes: “Death has occurred from the ingestion of as little as 5 grams. Ingestion of a single gram (a thirtieth of an ounce) has caused nausea, vomiting, ringing in the ears, delirium, a sense of suffocation, and

collapse. Industrial workers exposed to the vapours, without obvious systemic effects, suffered clouding of the eye lens."[58]

A 'Material Safety Data Sheet' on BHA lists the toxic effects on humans as follows.

1. Skin irritation with possible depigmentation. Prolonged or repeated skin contact may cause dermatitis.
2. Eye irritation, may cause chemical conjunctivitis.
3. If inhaled it could cause respiratory tract infection.
4. If swallowed it could cause gastrointestinal tract irritation with nausea, vomiting, diarrhoea and may affect behaviour and the central nervous system. Prolonged or repeated ingestion may affect the blood, metabolism, respiratory system, liver. thyroid, and adrenal glands.[46]

In respect of BHT, two cases of acute intoxication are noted in the OECD report. Two young women inadvertently ingested (4g and 80g of) BHT. They needed treatment for severe abdominal cramping, nausea, vomiting, and neurological disorders.[39]

Haas and Levin note that "BHT can be irritating to the liver and kidneys, especially when there is decreased function of these organs. Allergic reactions have been known."[22]

Dermatitis

These synthetic antioxidants have been found to cause dermatitis in a number of people. In one study, contact dermatitis was caused by TBHQ in a hair dye and cross sensitization with BHA and BHT was noted.[33]

There have been identified cases of contact dermatitis due to BHA in creams used for psoriasis, eczema and dermatitis.[40,52]

A problem with latex gloves was found to have nothing to do with the latex but with BHA.[43]

Contact dermatitis was caused in one individual by TBHQ in a cutting fluid[36] and in another by TBHQ in a vegetable hydraulic oil[1].

Antioxidants are routinely added to cosmetics. Reactions to these are often not identified unless specifically looked for. White et al routinely tested patients with

facial dermatitis with BHA and TBHQ and identified seven with an allergic contact dermatitis to an antioxidant in their cosmetics or toiletries.[56]

Urticaria

Urticaria has been linked with sensitivity to both BHA and BHT. In one study looking at the links between recurrent urticaria and food additives, 6 out of 47 people tested with BHA, and 6 out of 43 tested with BHT, experienced adverse reactions.[51]

In another study of urticaria sufferers, nineteen individuals had reactions to BHA and BHT.[17]

Two studies by Juhlin[27,28] found links between urticaria and BHA and BHT. The 1981 study challenge tested 330 individuals with recurrent urticaria with a range of additives. Tests were judged positive if there were clear signs of urticaria or angioedema within 24 hours. Of the 330, 156 were challenge tested with BHA and BHT, 15% had a positive reaction and 15% had some degree of a reaction.

In 1990 Goodman et al looked at the link between urticaria and BHA and BHT in two people who had suffered with chronic urticaria and angioedema for over three years. Both reacted to tests within 1-6 hours. It was discovered that the oatmeal that one individual had been routinely eating for breakfast contained BHA and BHT. Both did well on a diet that avoided both additives.[21]

One person developed contact urticaria due to BHT contained in plastic folders. Skin contact with the folders led to a strong urticarial reaction within 20 minutes.[41]

Whilst these studies all show a link between urticaria and BHA and BHT, the true extent of the problem is unknown. No check for links between BHA, BHT or other food additives is routinely made in cases of urticaria.

Skin Conditions: General

A number of studies have shown links between the use of creams and lotions containing BHA, BHT, and TBHQ and skin conditions. For some people these reactions will also emerge if the antioxidants are ingested in food.[45]

A young woman with a “cutaneous urticarial disseminated eruption” regularly used chewing gum. Investigations into the cause of her problems found that the BHT in the chewing gum was the culprit.[38]

"Some people are sensitive to the presence of BHT and develop rashes; they can be the same people who demonstrate aspirin sensitivity." [23]

Asthma

Few studies have looked at the links with asthma. Weber states that he is aware of an unpublished case of a drop in pulmonary function following a double blind challenge with BHT.[55]

Behaviour

When pregnant mice were fed BHA and BHT it affected the brain chemistry of their offspring, resulting in "approximately half the normal level of cholinesterose and serotonin". The affected mice weighed less, slept less and fought more than normal controls.[15]

A 1972 study involving mice, quoted by Winter, found that mice who had been fed a diet containing BHT or BHA gave birth to offspring that frequently had changes in the brain and abnormal behaviour patterns.[58]

Stokes and Scudder found that the chronic ingestion of 0.5% BHA or BHT by pregnant mice and their offspring resulted in a variety of behavioural changes. Compared to controls, BHA-treated offspring showed increased exploration, decreased sleeping, decreased self-grooming, slower learning, and a decreased orientation reflex. BHT-treated offspring showed decreased sleeping, increased social and isolation-induced aggression, and a severe deficit in learning.[49]

There is an interesting paper by Kato Junji et al that links BHA to undescended testis and ADHD (the paper is in Japanese so I have only been able to access the abstract). A boy born to a 34 year old woman had one-sided undescended testis. He also had other problems: "The infant was hyperactive, very demanding to his parents and short tempered". He was late in learning to talk, had problems socialising at elementary school and was diagnosed with ADHD.

The mother had taken vitamin supplements during her pregnancy and it was discovered that these tablets contained BHA. The study authors write that : "Recently it has been reported that BHA is estrogenic. It is one of the hormonally active agents which have the potential of causing undescended testis, ADHD and allergic diseases to a child when the child's mother consumes it during her pregnancy."

The woman had not taken supplements during her other three pregnancies and the other children had none of the problems described above.[29]

Part one of the Feingold Diet eliminates all foods with synthetic colours, synthetic flavours and the antioxidants BHA and BHT. The addition of BHA and BHT to the elimination part of the diet "was promoted by the clinical experience demonstrating that this class of compounds may induce behavioural disorders in some children".[14]

Cancer

One of the major concerns about BHA has been that, in high doses, it promoted forestomach cancer in rats and hamsters.[55] Now, we don't have forestomachs but as Hanssen notes "we do have similar cell lining in our mouth, throat and gullet".[23]

The US Department of Health and Human Services states in their report on Carcinogens that BHA is "reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity in experimental animals".[53] Okay, so we don't know for definite if BHA can cause or contribute to cancer in humans but we think that it just might...

I remain baffled when I am confronted with such statements. Surely, if there is any doubt then no substance should be classed as a GRAS substance (Generally Recognised as Safe) and surely we should be erring on the side of caution – not with ADIs, that no one understands, but with a ban.

There is also concern that "BHT may convert to other substances in the human body that may be carcinogenic. For example, one conversion product of BHT (the hydroperoxide form) has been shown to disrupt the chemcial signals that are sent from cell to cell."[22]

Some studies, including Gharavi et al[19] have shown that chronic exposure to TBHQ many induce carcinogenicity.

A leading manufacturer of BHA has the following caution on its product specification. "Warning! Possible cancer hazard. May cause cancer based on animal data. Risk of cancer depends on duration and level of exposure. Harmful if swallowed. Irritant. Causes eye, skin and respiratory tract infection."

Other Concerns

Animal studies have identified a number of other problems. For example:

> BHT caused lung damage and increased the incidence of liver tumours in mice.[55]
>
> Kahl and Kappis note that toxic effects to the lung have been observed with BHT, that BHA induces tumours of the forestomach of animals, that BHT induces liver tumours in long term experiments and so on. Their review concludes that BHA and BHT are tumour promoters and that, in contrast to them, Vitamin E is not carcinogenic.[30]
>
> Long-term exposure to BHT can result in functional and histological changes of lungs, liver, kidneys and thyroid.[39]
>
> It has been found that when used with BHT, twenty times the usual amount of BHA is stored in the body's fat. "Maybe this is why undertakers report that bodies take longer to decay these days."[23]

BHA affects liver and kidney functions which is worrying if the same applies, to any extent, in humans as it is the liver that detoxifies BHA within the body and the majority is excreted in the urine so it also has to be dealt with by the kidneys.

Some Observations

There are a range of studies that claim to have identified that BHA and BHT pose no cancer hazard and that they may even be anti-carcinogenic at current levels of food additive use.[57] Many of these studies are also dismissive of the study that identified BHA as causing cancer in the forestomach of rats. I'm not able to comment on the scientific rigors of that piece of research but I am able to make the observation that it is always easier to cast doubt on something that doesn't agree with your view than it is to prove that your view is in fact right.

Personally, I don't think the evidence is clear in either direction. The fact that an ADI is given for them indicates that they are certainly not safe to consume in large amounts. Gauging at what level they might be beneficial or harmful to any one individual is a far from straightforward process.

As we know that naturally occurring antioxidants in food do have anti carcinogenic properties, common sense would dictate our use of these rather than relying on ones that have been chemically synthesized and are only in our food because food manufacturers need to be able to develop products that have a long shelf life.

Reactions experienced by animals at high doses are explained away by saying that at high dosage levels there is a problem but not at low dosage levels. I have also seen animal studies dismissed as not directly relevant to humans – that they have to be used as a guide and interpreted yet it is this very process of interpretation that is so potentially harmful to us all.

My own view is that if there are negative health affects at high dosage levels then concern must be raised about long term human exposure – it is not as if we only come into contact with these antioxidants once every few months. Many of us, including children, are ingesting them a few times each and every day and we have no idea what the long term consequences of this are. Or are we already seeing these in the increasing numbers of children being diagnosed with ADHD and the epidemic of weight problems?

Health Benefits?

The use of BHT as an antioxidant in food has declined but it has emerged on the market as a health food supplement in capsule form. Why?

BHT has been shown to have some antiviral properties in some animal studies. This has led to interest in using BHT as a ‘cure’ for herpes, HIV and cancer. BHA and BHT have even been put forward as an anti aging treatment.

Studies with rats found that very large doses led to an increase in liver size, in lower doses it increased the incidence of liver tumours. Yet when rats were given BHT before a substance known to cause cancer the BHT seemed to enhance the detoxification process and may have protected the rats from its effects.

The result has been that some individuals have started using BHT in much larger doses than the ADI to help their health conditions. It is cheap to buy as a supplement and, apparently, is readily available so has been tried by many people. BHT has not been approved for use in this way and no one knows the long-term consequences of its uses.

Is it safe to use this way? I would say definitely not. I will let Dr Llauradol explain why.

On discovering that these synthetic antioxidants were being taken as dietary supplements Dr Llauradol, an advocate of their use as a food additive, felt compelled to raise his concerns:

"I wish to bring to the attention of physicians and health personnel that many years ago Denz and Llauradol reported dramatic, deleterious effects of" BHT and BHA.

"In well-controlled experimental studies Dr F. A. Denz[8] and I found that a series of daily doses of 1 gram of BHT (or BHA) given to rabbits by stomach tube led to muscular weakness, inanition and death... The organs most affected were skeletal muscles, kidneys and adrenal glands. We indicated that the possible cause of death was potassium depletion. At the time that we published our results, we believed that the relatively low levels of BHT and BHA used as antirancids for food preservation were not harmful to humans. In spite of the appearance in recent years of faddist groups vociferating against preservatives added to food, I still believe (Dr Denz is now deceased) that the above statement is true and personally felt for some time that I should not "reissue" our data because they could unjustifiably alarm consumers or might be misconstrued as a publicity seeking device on my part.

However, after reading that daily doses of 2 grams of BHT are recommended indefinitely "to attack" the genital herpes virus, I feel, in good conscience, compelled to draw attention to the toxic effects associated with the administration of BHT and BHA that have been experimentally demonstrated by us on rabbits. Daily doses of 1 gram given to rabbits were lethal in about two weeks. In terms of concentration of drug per kg of animal mass, the recommended human dose of 2 grams a day is simply one order of magnitude below the lethal dose. Obviously, smaller doses, if not lethal, must produce pathological effects."

"These agents may do in not only the virus itself, but indeed the host as well."[34]

Gallates

The problems with gallates are not as extensive as those with BHA, BHT and TBHQ. The most commonly reported adverse reaction to gallates is dermatitis. In one study 46 people had positive patch tests for 1 or more of the gallates. The most common complaint was cheilitis (inflammation and cracking of the skin of the lips), followed by dermatitis of the hands. The most common sensitizing agent was lipstick followed, in second place, by bakery goods. The main problem gallates were propyl gallate in lipstick and octyl gallate in bakery products.[18]

The problem with lipstick has been identified in other studies (e.g. Serra-Baldrich[47]) as has contact dermatitis (Wang[59]).

> Gallates are often used in the cosmetics and food industries (particularly in bakery goods). Octyl gallate, when mixed with heated chicken fat has caused an airborne contact dermatitis. There was a reported case of contact dermatitis in a baker due to dodecyl gallate present as an antioxidant in margarine. Lip swelling and or al ulceration have been reported as reactions to dodecyl and oct yl gallates. Chellitis and stomatis have been reported to octyl, propyl, and dodecyl gallates. In one case, a 6 year old boy had recurrent lip swelling for one year due to dodecyl gallate in margarine.[44]

Perez et al identified 55 people with positive reactions to propyl gallate. Their review found a statistically significant increase in propyl gallate positive rates on patch testing for contact dermatitis between 1998 and 2008. An increase in its use in the cosmetic industry may be the explanation.[42] One study found links between dodecyl gallate and chronic eczema.[6]

Winter notes that propyl gallate can cause stomach or skin irritation especially in people who suffer from asthma or are sensitive to aspirin. [58] The gallates are generally recommended for exclusion on diets for children with ADHD.

Gallates have been found to cause certain problems in animals including growth retardation, anaemia, kidney and liver changes and hyperplasia of the forestomach.

Identifying gallates as the cause of problems is not a si mple process. In some cases there is a delay of over 5 day s to some allergic patch testing including dodecyl gallate and these reactions can be missed if no follow up takes place.[7]

Hidden Antioxidants

Antioxidants, because of their anti-spoiling properties, are added to a wide range of products and substances at various stages in the food manufacturing, storage, and distribution process. For example, BHA is used:

- in adhesives used as components of articles intended for use in packaging, transporting or holding food;
- as a defoaming agent in the manufacture of paper and paperboard for use in food packaging;
- in the manufacture of resins and polymeric coatings for food contact surface articles used in the manufacture, processing, packaging and transportation of food;
- as lubricants with incidental food contact intended for use on machines that are used in the production, manufacture, packaging, preparation, treatment, packing, transport or holding of food;
- in pressure sensitive adhesives which may be used as the food contact surface of labels and/or tapes applied to raw fruit and vegetables;
- as an antioxidant for polyethylene and polypropylene compositions used in contact with foodstuffs or water intended for human consumption.[48]

Ingredients List

Additives generally have to be listed on the food label's "list of ingredients" and in the correct position in order of weight with the greatest first.

But, there are exemptions to these rules.

- Some food ingredients need only be identified by a generic term (such as oil or spices) and additives used in such ingredients need not be named.
- Additives contained in ingredients of a food need not be listed as long as they do not perform a technological function in the final foodstuff.
- Additives used as processing aids need not be listed.

Any food that contains vegetable oil, lard, shortening, or animal fat may have been treated with a synthetic antioxidant at some stage in its manufacture.

Cereals and grains are often perceived of as healthy foods which, in their natural state, they are but during the manufacturing process many will have been treated with a synthetic antioxidant. Madhavi[35] provides us with a number of examples that demonstrate the widespread use of synthetic antioxidants:

"BHA and combinations of BHA, BHT, and propyl gallate increase the stability of wheat germ meal, brown rice, rice bran and dry breakfast cereals.

"A combination of BHA and BHT is highly effective in stabilising shelled walnuts, ground pecans and peanuts. BHA is effective in stabilising the fresh aroma and flavour of roasted and salted peanuts when added to the cooking oil and salt. BHA is effective in stabilizing a variety of shelled nuts when incorporated in an edible protective coating. BHA extends the shelf life of roasted macadamia nuts and almonds."

"The volatility of BHA and BHT is an advantageous property in low fat foods. Small quantities of BHA or BHT added to the potato or cereal slurry before cooking or drying results in dispersion by volatilization or steam distillation, resulting in the protection of the product during processing and subsequent storage, Such products are also stabilised by the addition of relatively high concentrations of the antioxidant to the inner waxed liner of the packaging material."

BHA is "effective at stabilizing the fresh pigment of raw beef and inhibits lipid oxidation at 1%."

"Combinations of BHA and BHT are effective in mechanically deboned carp, ground turkey meat, Chinese fried pork fibre and frozen bacon slices. In combination with sodium tripolyphosphate and ascorbic acid, BHA retards the development of rancidity in frozen restaurant pork chops. It is effective in freeze-dried beef, fowl, pork and fish. A combination of BHA and ascorbic acid has been reported to be effective in retarding lipid and pigment oxidation in raw ground beef for up to 8 days of refrigerator storage in oxygen permeable film."

> "BHA is slightly effective in increasing the shelf life of foam-dried whole milk powder at 0.01%"... " markedly improves the keeping quality of processed cheese stored under varying conditions at 5° or 20°C.

> Found in spices, nuts and confectionary BHA is "effective in stabilising the color of paprika and cayenne peppers."

> "Addition of BHA or a combination of BHA, PG and citric acid inhibits oxidation in candies when added to the butter used for preparing candies." [PG is propyl gallate]

Within a production run of a foodstuff, the level of food additives present may vary slightly between individual products. Whilst it is recognised that some variation within a bat ch might occur, the onus is upon manufacturers to ensure that maximum permissible additive levels are observed for each of the individual products. But, you as the consumer, will never know the exact amount of synthetic antioxidants in the bag of salted peanuts or crisps (chips) that you are eating.

Processing Aids

A wide variety of processing aids are used in the manufacture of foodstuffs. These are not included on the list of ingredients as they are not classed as being part of the food itself.

Residues of the substance used as a processing aid, or its derivative, may be found in the final product. EU law states that these residues must not have any technological effect on the final product or present any health risk.

Unfortunately there is, currently, no EU positive list of processing aids so we are left in the dark as to what the full list of these aids might be. We do know that food additives can and are used as processing aids. The only guidance in respect of food additives is that they should not be used to mask the use of faulty raw materials or undesirable practices.[20]

We know that BHA is used as a defoaming agent in the processing of food.[48] It seems highly likely that the synthetic antioxidants appear in other processing aids.

Packaging

The general rule is that packaging materials must not allow their constituents to migrate into the food in a quantity that could harm human health or affect the nature or the quality of the food. Fact: chemicals, including BHA and B HT, do migrate from packaging materials into food.

In the EU, the gallates, BHA and BHT are permitted in the manufacture of plastic materials and articles intended to come into contact with food. Migration limits are set and migration shouldn't

1. have a technological function in the foodstuff;
2. exceed the limits in food law for their use as authorised food additives or flavourings; or
3. exceed the limits in foodstuffs where their use is not authorised as a food additive.[12]

The legislation requires that paper and board of one or more layers and intended to come into contact with foodstuffs, should not under normal and foreseeable conditions of use, transfer constituents to foodstuffs in amounts that could endanger health or change the nature or properties of the foodstuff.

Yet both BHA and B HT are important additives used in packaging materials "because they are able to migrate into foods". And it is for this reason that antioxidants are either added directly to the wax used in making internal liners or applied to the packaging board as an emulsion.[4]

Maldahavi[35] tells us that TBHQ is particularly useful in retarding oxidative rancidity in lard when incorporated into the packaging material and that its is as effective as BHA when incorporated in waxed liners in packaging materials used for breakfast cereals. "BHT was identified in solvent extracts obtained from paper and board materials intended for food contact".[48]

Propyl gallate is used in pressure sensitive adhesives on the food contact surface of labels and tapes applied to food. It is also sometimes added to "inner packaging material of foods like breakfast cereals and potato flakes, so it is possible that its vapour could contaminate the food".[23]

Passive food exposure to BHA and BHT occurs "through their use in food packaging materials like pressure-sensitive adhesives, paper and cardboard, lubricants and sealing gaskets for food containers."[55]

Terada and Naito looked at whether BHT migrated through the airspace in packaged food where there is only partial contact between the food and the packaging. Their results confirmed that migration of BHT occurs from film to food even when they are separated completely by an airspace between them.[50]

Synthetic antioxidants are used for packaging materials because they are cheaper, easier to use, and have a longer lasting effect than natural ones. However, the more natural antioxidants are less likely to migrate into the food. The antioxidant a-tocopherol was demonstrated to migrate from low-density polyethylene film into sunflower oil (used as a fatty food simulant) over seven weeks at a lower rate than BHT.[55]

BHA and BHT are used in the manufacture of polyethylene film for wrapping food. Ready to eat cereals are usually wrapped in an inner liner that has been treated with a synthetic antioxidant to help maintain the freshness of the product. BHA, BHT, and TBHQ in the packaging are surely ways by which food manufacturers are able to get these into foods without having to declare them on any ingredients list. Food manufacturers are very aware of how consumers perceive additives and are continuously attempting to find ways around our worries except in the one way we would most like – a reduction in synthetic food additives anywhere near or in our food.

The regulations state that they should not "have a technological function in the foodstuff" yet, by their very nature, any migrating antioxidants will have an antioxidant effect on the food – if they didn't food manufacturers would not use them in this way.

And it doesn't just apply to food: "Several examinations exist that show the migration of BHT from plastic films into foodstuff and cosmetics. The migration rate depends on the chemical structure of the polymers, the auxiliary products (e.g. plasticisers) contained therin, the contents and the storage temperature and period."[39] The same report also notes that significant release into the environment is expected from migration of BHT onto the surface of products containing it. It also gets released into the air from tyre abrasion and finds its way into our rivers and soil. It has been identified in algae, snails and fish.

Active Food Contact Materials and Articles

There has been a rise in the development of "active food contact materials and articles" that are intended to extend the shelf life or maintain or improve the condition of packaged food. They are designed to deliberately incorporate components that would release or absorb substances into or from the packaged food or the environment surrounding the food. There are also "intelligent food contact" materials which monitor the condition of packaged food or the environment surrounding the food.

As with other packaging materials these do have some regulations attached to their use but they are somewhat vague. Under normal or foreseeable conditions of use, they should not transfer their constituents to food in quantities which could:

- endanger human health, or
- bring about an unacceptable change in the composition of the food, or
- bring about a deterioration in the oranoliptic characteristics thereof.[10]

Information on these new forms of packaging is quite limited and the EU has as yet to draw up a list of approved materials so we are very much in the dark but I think we can safely assume that some of their constituents will migrate into food. As antioxidants play such a major role in delaying the food spoiling process I would guess that BHA, and the others, will be playing a role somewhere in the process.

Until I started the research on this book I had given little thought to food packaging materials – I think I saw them as something very separate from the actual food and certainly as 'safe'. I am now deeply concerned, and shocked, at the way in which food manufacturers appear to use the regulations to incorporate synthetic antioxidants into food without us knowing. Whilst writing this book I contacted various manufacturers of cereals to ask about whether antioxidants appeared in their packaging material – the most common response was to avoid the question and the worst offenders at refusing to give a direct answer were manufacturers of organic cereals.

Flavours and Colours

One of the most problematic sources of hidden additives is in "flavourings". Lists of ingredients may mention that a product contains added flavours but rarely provides you with any further information. The reality is that these artificial flavours are often incredibly complex products in their own right and in many cases will include food additives.

> "The level of additives in flavourings shall be limited to the minimum necessary to guarantee the safety and quality of flavourings and to facilitate their storage. Furthermore the presence of additives in flavourings must not mislead consumers or present a hazard to their health."[11]

At the present time, if a flavouring contains an antioxidant you will not know.

Feingold found that BHT may be incorporated into annatto and beta-carotene colourings used often in products such as cheese and margarine. Please note these are often listed as 'natural' colourings and on the surface do seem as if they will be safe but these can often be a source of hidden problems.[13]

Dietary Supplements

Dietary supplements such as vitamin formulations are highly complex products and, some, could contain hidden food additives. For example, we know that BHA is used as a stabiliser for vitamin A.

> BHA is used in the manufacture of lipd soluble vitamins.[20]

BHT and BHA may have been us ed to preserve vitamins in products such as cereals. Feingold noted that vitamins A, D, and E frequently contain BHT.

Workplace

There are further risks of exposure for people who work in the following types of occupations:

Food producers
Animal feed producers
Livestock producers
Cosmetic manufacturers
Some petroleum workers
Rubber producers and those who handle the end products such as tyres
Fast food workers who cook and serve fried and oily foods

> The “potential for consumer exposure to BHA by ingestion and dermal contact is widespread”.[53]

Avoiding Gallates, BHA, BHT and TBHQ

Avoiding these food additives is extremely difficult. They occur in so many of our foods that unless you only prepare and cook fresh food you will ingest some virtually every day. Even if you diligently avoid processed food you will still come into contact with some of them in food packaging materials, toiletries, and medicines.

You can, however, reduce the amount you ingest dramatically.

1. Read all food labels and avoid any food that has them listed.
2. Avoid eating processed food that contains oils and fats.
3. Buy, prepare, and cook as much of your food from fresh as is possible.
4. Use organic spices and cold pressed oils.
5. Request information on antioxidant usage in packaging material from food manufacturers.
6. Check all cosmetics and toiletries and change to brands that do not contain them
7. Check all forms of medication. If any contain these additives then talk to your doctor to see if an alternative brand can be prescribed for you.

The additives to avoid are:

E319 TBHQ (Tertiary-butyl hydroquinone)
E320 BHA (Butylated hydroxyanisole)
E321 BHT (Butylated hydroxytoluene)

E310 Propyl gallate
E311 Octyl gallate
E312 Dodecyl gallate

If you decide to reduce your exposure, keep a food diary (you can download one for free from www.foodcanmakeyouill.co.uk) and monitor any changes. Check the food lists given in early chapters and the section on hidden additives. If you have any concerns do consult with your doctor before making any changes and please do not stop any prescribed medication without your doctor's permission – you could endanger your health and, depending on the medication, even your life.

It can take some time for these additives to leave your body. They are primarily excreted in the urine.

In respect of TBHQ excretion seems to be essentially complete after 2-4 days.[9]

BHT seems to accumulate in adipose tissue (fatty tissue) with lower levels found in the liver. It takes about 7-10 days to leave the body once a person has stopped ingesting it. However, one study showed that only 68% had been excreted within 11 days.[39] We have no idea how much longer it takes for the remaining 32% to leave.

You will need to try avoid them for at least 2-4 weeks. Some positive results may occur quite quickly but others will take time to appear as your body needs to 'detox' itself.

End Word

Review committees have always decided that the benefits of synthetic antioxidants outweigh the potential risks. For many people these risks will be negligible but for some they will be life limiting.

There are definitely reasons to be concerned about the long-term use of synthetic antioxidants on our health. It would seem far more logical if food manufacturers switched to solely using natural antioxidants, which we know are safe, but this will not happen and the reason is one of pure economics. Food manufacturers need the foods to have long shelf lives and these can simply not be obtained with the natural antioxidants. The reason that they cannot be obtained with natural antioxidants is simply that food does go off – freshness is very time limited. Even vegetable oils that are high in natural antioxidants will eventually go rancid, to prolong their 'on the shelf lifetime' synthetic antioxidants need to be added. Any food that contains oil or fat that has been processed is likely to contain these life extenders.

Concerns about food additives aside, we have to ask ourselves whether it is good for us nutritionally to have the life of food extended in this way.

The use of ADIs for food additives is another area of concern for me. The very existence of an ADI for any substance indicates that it is not 100% safe. And just how useful are these figures? They vary from country to country and will also be influenced by age, sex, and lifestyle. Whilst as much data as is possible is used to establish ADIs my own view is that these are still only a best guess. Writing about BHT, Sheftel notes that "it cannot be excluded that ADI for BHT is exceeded in all ages and sex groups."[48] Most of the time we will be unaware that we may be exceeding the 'safe' amount.

Certainly as an individual, you would not be able to calculate the amount of BHA, for example, that you had ingested. Even if the exact amount was stated on each item and you did the calculation according to your weight and the other foods you had eaten that day that contained BHA you would still not have a complete picture. How much had you taken in from ingredients that had not been listed? Was there any on the packaging and if so what amount was likely to have migrated into the food you ate? Had any been used a processing aid?

The scientist would say that you don't need this information as the amounts are negligible but the reality is that these amounts can cause problems especially if they ingested daily on a long term basis.

The interpretation of results from animal studies is a further area of concern. Synthetic antioxidants have been found to cause cancer, tumours, liver damage, behavioural changes and a host of other health problems yet are classed as safe. Does that make sense to you? If the results from animal studies hold no relevance to what happens in the human body then why bother inflicting pain and suffering on the animals in the first place?

Ironically, at the time of writing this book there is a push within the food industry to add natural antioxidants to prepared foods so that they can make claims of how health promoting their foods are. I suspect that even though they may add vitamins such as C and E into their products, there will still be the usual amounts of synthetic antioxidants in the product and/or in the packaging. We must never forget that the food manufacturer's first priority is to maximise profits not to look after our health.

Appendix One: Antioxidants allowed in the UK

E300	Ascorbic Acid
E301	Sodium ascorbate
E302	Calcium ascorbate
E304	Fatty acid esters of ascorbic acid
E306	Tocopherols
E307	Alpha-tocopherol
E308	Gamma-tocopherol
E309	Delta-tocopherol
E310	Propyl gallate
E311	Octyl gallate
E312	Dodecyl gallate
E315	Erythorbic acid
E316	Sodium erythorbate
E319	Tertiary-butyl hydroquinone (TBHQ)
E320	Butylated hydroxyanisole (BHA)
E321	Butylated hydroxytoluene (BHT)
E586	4-Hexylresorcinol

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Useful Links

Food Additives - Current Community Legislation (EU)
http://ec.europa.eu/food/food/chemicalsafety/additives/comm_legisl_en.htm

Food Standards Agency (UK)
http://www.food.gov.uk/

International Programme on Chemical Safety
http://www.inchem.org/

Office of Public Sector Information (UK)
http://www.opsi.gov.uk/index.htm

US Food and Drug Administration
http://www.fda.gov/

US National Toxicology Program
http://ntp.niehs.nih.gov
This site has the most recent “Report on Carcinogens” (Eleventh Edition) available for download.

For more information on Food Intolerance please visit the
Food Can Make You Ill web site
www.foodcanmakeyouill.co.uk

Other books by Sharla Race:

Change Your Diet and Change Your Life
The Salicylate Handbook
Migraine and Food Intolerance
Chocolate, Cocoa and Health
Tartrazine