Total Food Safety

Alternative names: Food Safety for Dummies
Food Safety and HACCP without Tears
Food Safety Awareness
Zero Defects Food Preparation
Effective Food Safety Team Building

A must for all food handlers.

By Joseph Tanti MLS BSc MSc MSB CBiol MCQI FRSPH

About the author:

Jo has graduated as a Medical Laboratory Scientist in 1975. He specialized in Applied Bacteriology and has always been associated with Quality and for this reason he set for MSc in Total Quality Management from Sheffield University. He strongly believes that Quality is not a paper exercise but turning the organization into a living organism. Thus, it can react to new rapid changing business scenarios. His motto is "to leave this world a better place than I found it".

This book is dedicated to my family and staff (with special mention of my Personal Assistant Christianne Grech [the only one who can read my handwriting] who all supported me by appreciating my long times away from the office - in my quest to improve my knowledge and to work with the objective of helping companies change their culture into one of Total Quality Management; thus ensuring that food safety becomes part of the software of the brain of every food worker with the objective of preparing 100% safe food.

Joseph Tanti

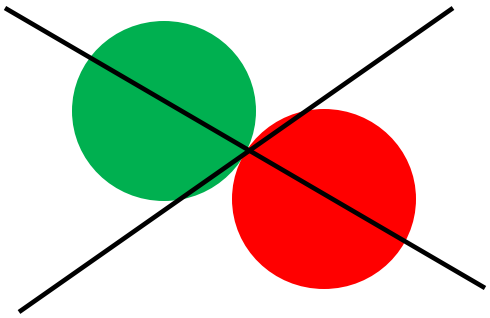
Preface

We are what we eat. Each day an average person goes through a number of times where he or she stops to eat something. If we eat 10 items per day that means that 3650 items, including water and beverages, go through our digestive system every year. If we consider how many people are involved in the preparation of each item over a 60year lifespan – considering a conservative figure of 10 people involved in the preparation of one item - a staggering 2,000,000 people were involved in what one is made up of. We hope that each and everyone does his part!

Thank God, we trust our food handlers. But food handlers eat as well. So as food handlers, we are legally and morally bound to do our utmost to produce safe food and other food related items like containers, detergents, wrappers, disposable and non-disposable cutlery and more.

Everyone needs food and so I recommend that you spend a few minutes to read this simple and innovative way to produce safe food using the Traffic Light System.

The content of this course is enough to cover the requirements of basic food handling. The barest essentials can be read in 5 minutes, but the most important issue is the **awareness**. Food handlers MUST be aware of their status, the food they are handling and the tools and accessories they are using. This is why we promote the traffic lights system, as we have to see Ready-to-Eat food as GREEN while dangerous and hazardous food as RED. The most important issue is to keep them apart as RED AND GREEN TOGHETHER SHOULD NEVER BE SEEN – green food or objects turn red once they come in contact with red food or objects.



RED and GREEN together should never be seen!

Abstract of the course – Link to outcomes

In a nutshell, this book gives you food handler/s the basic knowledge to be prepared to become "competent" in the process you will be owning. The knowledge helps you continuously improve it and go for a "Zero Defect" / Total Food Safety HABIT.

This course is divided into 3 sections vis:-

Section 1 – Introductory

- Why are we reading this book?
- What are your responsibilities?
- What is due diligence?
- High risk groups
- You will get to know what harm food can do (excluding excessive eating) and the symptoms
- You will get to know what bacteria needs to increase in numbers and how fast they grow
- You will be introduced to the traffic lights system to raise your awareness

TEST 1

Section II – The type of food and food hazards

- How to learn categorizing food into red and green using the traffic light system
- Get to know what are the **hazards** that make food dangerous to eat
- Get to know which food brings about food allergies

TEST 2

- You will learn what is the Danger Zone and which type of food allows the multiplication of bacteria if left in this range of temperature
- You will be introduced to some bacteria which cause food poisoning
- You will be introduced to the traceability law and its meaning

TEST 3

Section III – The Solutions

- You will learn what is a process and how to draw a process model
- You will learn what are the seven important areas to produce safe food and some practical examples of record keeping
- You will be introduced to the meaning of HACCP and how to actively participate to prevent food hazards using the process model and using the colours of the traffic lights

TEST 4

FINAL EXAM

REMEMBER:
Some foods called HIGH RISK FOOD allow the growth of BACTERIA if left in the DANGER ZONE . This is between 5°C and 63°C

Some initial thoughts – Why should you read this book

When I deliver the content as an 8hour course, I always start by presenting 10 facts related to food which I pass on to my students. They are asked to state, which one of the following statements, in their opinion, is NOT true. These are: -

1. The number of food poisoning cases in many countries are on the increase
2. In many countries, around 50% of food poisoning cases are coming from households
3. WHO has stated officially that we are losing the battle against the bugs
4. By 2050 practically all antibiotics will be useless to treat bacterial diseases due to the development of superbugs
5. There is a continuous increase in the number of new emerging diseases
6. In many countries, food is handled along the chain by untrained food handlers
7. Many think that the only thing food can cause is the relatively harmless food poisoning while in fact there are another 9 bad involuntary effects that food can bring about (excluding over-eating effects like obesity, diabetes, heart conditions and high blood pressure)
8. In many countries, food handlers who fail to produce safe food are fined heavy sums and even imprisoned for their shortcomings
9. My interest in food safety stems from the fact that I lost my grandma and her sister at the age of 32 and 28 respectively to typhoid fever because they drank water from the well without boiling while boiling water for her husband and five boys aged 3 months – 10 years
10. 50 % of the world's food production is being thrown away!

What do you think? Turn to the last page for the answer. The reason for asking these questions is for you to understand *why* you need to understand and implement the content of this handbook. It is meant to improve your **knowledge** because this course is about knowing **what to do.** This is about changing your **ATTITUDE** towards the task of producing 100% safe food. **It must become part of the software of your brain** (see page 7).

The concept of *tacit* and *explicit* knowledge

Explicit knowledge is that knowledge contained in this course. We run a course which is hands-on and this is about ***tacit knowledge.*** These are the HOW to do things and this course offers **competency** training and certification. For more details write to us on info@tantiandmallia.com or call +356 21667370 / 79667370 or visit our website www.tantiandmallia.com

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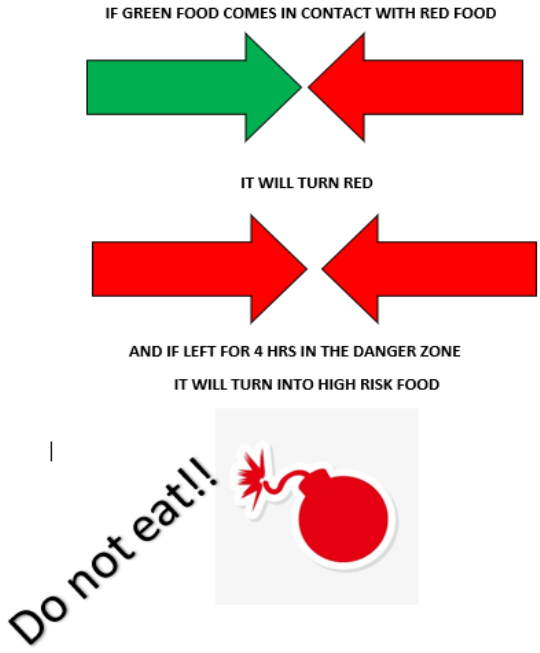
What we get out of the system is what we put in it.

LET US ALL PLAY OUR PART TO PRODUCE SAFE FOOD FOR EVERYONE, INCLUDING OURSELVES.

Chapter One - Awareness and the Traffic Lights System

In my preface I emphasized that food safety must become part of the software of our brain. To simplify this, we will be introducing the Traffic Lights System. I am sure that everyone in the world knows that RED means STOP, and GREEN means PROCEED. So as a food handler, you must start seeing things in a food preparation environment either RED or GREEN. Green means OK and safe i.e. ready-to-eat food. Unfortunately, we all know that micro-organisms, like bacteria and fungi, can grow on certain types of food which we will be labelling as HIGH-RISK FOOD. Please note that this does not automatically give this food the colour red. All we are saying is that ready-to-eat food MUST be GREEN and that if it is made up of HIGH-RISK INGREDIENTS, it can TURN RED if this is left for some time in the danger zone - **THIS IS FROM 5°C TO 63°C** (REMEMBER - THE AGE WHEN WE STARTED SCHOOL AND WHEN WE STOP WORKING). We will talk about micro-organisms in another chapter where we will discuss what they need to multiply and how fast they grow.

In the traffic lights system, RED is like wet paint. WHATEVER touches with RED become RED. Being dirty or clean has a different meaning because we can have areas which are clean or look clean but are RED while we can have something which is apparently 'dirty' but it is GREEN. Examples are hands which appear clean while in fact are RED because they would have come in contact with something RED. On the other hand, a plate which has just had a piece of cake on it, might have crumbs appearing 'dirty' but in fact it has a GREEN status.



REMEMBER:
Bacteria can multiply in 15-20 minutes if they have the right conditions.

Life would have been very easy if RTE (ready-to-eat) foods stay GREEN because all we have to do is just keep RED items away from GREEN ones, thus avoiding CONTAMINATION. We have to keep this firmly in mind - RED is like wet paint. Anything that touches with RED will turn RED. So, if we have a used carton box which is apparently new but was used to carry banana, then the status of the box is RED and cannot be used to store or transport unwrapped bread. Bread is RTE and is GREEN. If placed in the banana box, bread loses its status and turns RED.

In a food preparation area so many things happen especially when under stress. It is important to look at things and see them either as RED or as GREEN. We HAVE TO KEEP THEM APART. Our rule MUST be: RED and GREEN ***together should never be seen!***

For this reason, we always say that we must bring our brains along and become COMPETENT in our processes (we will explain this term later). We must own our processes and continually strive to improve them. Every process owner is the champion of his process. COMPETENCY is the result of becoming skilled and doing things without even thinking. It is like driving a car. It is good to know what the various car parts do e.g. the steering wheel, the brake, the accelerator. This is KNOWLEDGE – knowing what to do. SKILL is knowing HOW to do things and once it becomes part of the software of the brain, then you are competent, and you can produce safe food without effort, without tears.

Every person in the food chain is responsible for his/her process/es. This is the only way we can ensure obtaining 100% safe food. It seems impossible, but we have to keep working with a "Zero Defect" mindset, to reduce the risk to a minimum - practically eliminating the risk or reduce to an acceptable level.

At this stage, one has to introduce the concept of ATTITUDE and this is the WHY we do things. We said that safe food is a MUST. We must do our part while others do theirs. EVERYONE must do his utmost. Along with our hands and brain, we must use our heart. Safe food is not a result of a stroke of luck, but it is the result of our genuine collective effort, our awareness, our full attention and commitment. How can we trust other people's food if we know that we are not doing things right on our end?

We must stress at this point that not only bacteria are the cause of turning food red. We will later talk about other factors, i.e. hazards, which turn the food red. Unfortunately, food safety books are more concerned with the problems brought about by micro-organisms. These are normally given more attention as the resulting effects are immediate and statistics are based on mainly the classical food poisoning. These other factors generally cause long term harm and it is very difficult to relate them to the original cause. These will be dealt with later on.

One final note before going on to the next chapter - What about the orange/amber light of the traffic lights? We will deal with this when we talk about the HACCP.

The principles of HACCP, seven in all, are geared to put us in a mind frame of being PROACTIVE. So when the routine food safety factors become part of the software of the brain, we will go one step further – trying to identify POTENTIAL HAZARDS and adopt monitoring schemes to prevent them.

Chapter 2 – Damage brought about by food, to our body

Adverse health effect due to food consumption.

As mentioned earlier, we are what we eat. We drink or eat our food through our mouth, the first step being the chewing and crushing of the food. The food passes through an unbelievably long tube and is meant to be broken down into the building block of our body. One compound of food are the carbohydrates, which are broken down to sugars, which in turn provide energy, while proteins are broken down to amino acids which provide for the formation of new cells which form tissues and organs. These are absorbed through the walls of our intestines. When we ingest something which causes harm, many things can happen. These are called HAZARDS. A food hazard, as referred to by the *Codex Alimentarius*, is '***a biological, chemical or physical agent in, or in conjunction of food, with the potential of causing an adverse health effect.***' These will be described in the next chapters.

We will not be dealing with the adverse effects of eating excessive amounts of food which bring about detrimental effects like obesity and its complications, but we are talking about food which is supposed to be safe and ingested by people to sustain their growth or energy needs. Unfortunately, there seems to be a rising trend in certain diseases and conditions like an increase in allergic reactions, unexplained cancer cases and dementia. It is true that people are living longer due to the modern advances of medicine, but it is also the time that we are facing threats like new emerging diseases and superbugs. These are affecting not only those in the high-risk category i.e. old aged people, pregnant women, hospital patients and immuno-compromised people together with young children. There is a general feel that adverse effects are only the classical food poisoning cases which bring the uncomfortable situations of diarrhoea, vomiting, cramps, nausea, fever and possibly dehydration leading to death. Cancer cases are on the increase and so are allergic reactions. It is very difficult to prove the origin of these and find a correlation. With the recent horsemeat fraud still fresh in our minds, it seems food is an easy target for criminal minded food producers. If these were caught by chance, what about the other cases which have not been forgotten like the milk with melamine adulteration? With so many convenient foods made from ingredients from all over the globe, how can we ensure the reliability of the traceability?

Allergies now seem to be a common thing. There are people who have developed some form of allergies throughout their life. An allergy can also be brought about by the consumption of fish which produce scombroid toxins (due to poor storage conditions) and this affects everyone (not only the allergy sufferers). Large fish can also cause an adverse effect due to accumulation of mercury in the body. There is no way to remove the accumulation of certain toxins like lead, mercury and cadmium. Other accumulation residues are those of pesticides. It is hard to quantify

or study these trends, as these effects emerge long after consumption. There are also bugs which cause harmful effects other than food poisoning which appear after days of being consumed. Classical examples are Brucellosis, which has its typical uncomfortable effects, CJD (Creutzfeldt–Jakob disease), parasitic infections, etc. CJD normally leads to a slow death years after ingestion of the prions, which enter the brain cells leading to a sponge-like formation in the brain. Parasites like tapeworm and *Entamoeba histolytica* will cause debilitation and is very hard to associate with what food was ingested. Long term effects also include stomach ulcers and internal injuries, kidney and intestinal damage. Certain food-associated bacteria can cause miscarriages. All these are very serious, and these can lead to death. (Further down, a whole chapter is dedicated to allergens in food).

Chemical hazards can bring about death and these include poisonous fish and plants, mushrooms and bacteria. The list is endless, but I cannot fail to mention the effects of shellfish poisoning which can cause diarrhoea, amnesic shell fish poisoning, paralytic shellfish poisoning and death.

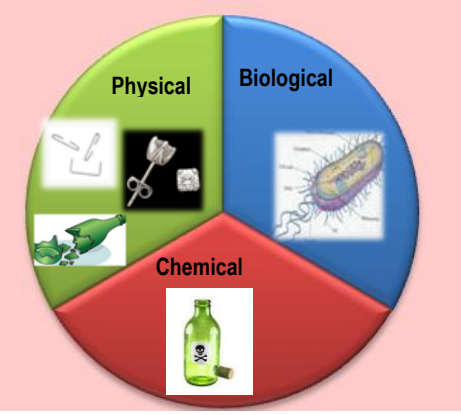
So as one can see, the food industry is a very serious business which calls for a lot of responsibility. Therefore, food handlers must be competent, and their actions must be fully accountable. Traceability has now been established in Europe for almost 15 years but accountability along the food chain should also be enforced. Each step in the manufacturing of food should be accounted for if we want to eliminate completely food fraud and adverse effects due to carelessness and irresponsible stakeholders.

Chapter 3 – The Hazards

In the previous chapter, we quoted the *Codex*'s definition of HAZARD. This brief definition explains that such an unseen "foreign" substance or state will bring adverse effects on our body. Since we do our best to present food in the nicest of ways, and since food is a necessity to keep us going, it is very easy to make others consume what we prepare. UNFORTUNATELY, food that contains a hazard appears just as good as one which is perfectly safe. Once again, it is of utmost importance to understand that every food operator has a **legal** and **moral** obligation to do his utmost to ensure that NO HAZARDS enter the food or food related items.

There are three types of hazards vis :-

- Physical Hazards
- Chemical Hazards
- Biological Hazards



Although most food safety books emphasize the importance of biological hazards, the most dangerous is the chemical hazard because rarely does it cause an immediate effect which is reversable. This is possibly the only hazard which is irreversible. They are today's silent killers because they end up in our own body and effect our physiological processes in an irreversible way. They can also trigger genetic changes that initiate universal changes in the body.

Each food operator is responsible to ensure that no hazard ends up or increase in the food or process that he is entrusted to do.

○ THE PHYSICAL HAZARDS

Physical hazards are those items that can cause a physical injury once it enters our digestive tract. These can vary from an unexpected hot food product to a fish bone in which one can choke on to death. We cannot ASSUME that the person about to eat our fish knows that it might contain a bone. He must be told. Below is a list of some of the hazards which have found themselves in RTE green food: -

1. Metal/glass/hard plastic fragments from knives, instruments and tools
2. Toothpicks
3. Nails, pins, staples
4. Bones and shells/stones from animals and fruits

5. Ear and nose pins, jewellery
6. Stones, eggshells
7. Fishhooks
8. Foreign objects like hair which can trigger a cough
9. Very hot food
10. Radiation residues in food
11. Nails (artificial)

○ THE CHEMICAL HAZARDS

Chemical Hazards are soluble invisible materials which bring an adverse effect in the human body, even in the smallest quantity. These have no taste and give no warning. These normally end up in the food either intentionally or unintentionally and as stated previously, can gradually bring about an adverse effect. Unfortunately, it can also lead to death. The list below shows some classical examples: -

1. Vermin and pest poisons
2. Fuels
3. Non-food grade cleaning and disinfecting materials
4. Toxic paints
5. Heavy metals like Mercury (found in large fish and thermometers), Cadmium, Lead, Arsenic
6. Poison found in fish (puffer fish) and poisonous mushrooms and red kidney beans
7. Toxins (poisons) formed by micro-organisms and aflatoxins as a result of mould growth
8. Pesticide residues
9. Antibiotic residues
10. Preservatives and other additives (e.g. colors, thickeners, artificial flavors especially when used in excess)
11. Hormones
12. Dioxin
13. Acrylamides
14. Prions – protein fragments which bring an irreversible damage to the brain
15. Overused frying oil
16. Scombroid toxins from certain fish

○ THE BIOLOGICAL HAZARDS

These are living organisms which can be transmitted via foods. The biological hazards are those that can get into our body and into our blood stream via the intestinal walls and end up INSIDE our body and cause inflammation and damage to our organs and tissues. Such changes can lead to death as for example dehydration due to the bacterium *Vibrio cholerae,* the agent for cholera. But bacteria are not the only food-transmissible organisms, as we find VIRUSES, which are organisms much smaller than bacteria, which can cause severe diarrhoea. The most notorious is the NORA virus which spreads like wildfire. But it is not just these two living micro-organisms that cause biological hazards but also the protozoan parasites which bring about infections together with worms and other flukes and tapeworms. The latter, although not microscopic when they grow, enter the body when they are still in a microscopic form.

Some micro-organisms do not bring about infectious and harmful changes to the human body directly but can produce toxins and poisons which still harm the body, sometimes immediately by causing vomiting and similar food poisoning symptoms. They may cause illnesses like cancer due to their carcinogenic characteristics. This is the commonest in fungi or moulds - another type of micro-organisms which grows on food. Algae, another form of micro-organism, can reside in shellfish leading to notorious shell fish poisoning. But in reality, these groups cannot be strictly placed under biological hazards as it is their chemicals that bring about problems. Unfortunately, many of these chemicals do not break when heated even though the micro-organism itself dies.

Most organisms related to food hazard die at a temperature of > 72˚C but once we allow the ones that produce the poisons to release their harmful byproducts, the cooking will not make any difference. Eating these poisons will lead to the undesired adverse effect of food poisoning.

Chemical and physical hazards are practically irreversible. One has to be extremely – it is a myth that heat changes everything to GREEN. THIS IS COMPLETELY FALSE. Heating, only eliminates the biological hazards as these are killed. On the other hand, heat has ABSOLUTELY LITTLE OR NO EFFECT ON CHEMICALS AND PHYSICAL HAZARDS

Physical	⇒ heat	**remains RED**
Chemical	⇒ heat	**remains RED**
Biological	⇒ heat	**remains GREEN**
	>75°C	

Chapter 4 - Bacteria & moulds - Their role in Food Safety

Bacteria and moulds are two completely distinct micro-organisms which play a very important role in our lives. Now let me start by stating that these two specific micro-organisms, which are completely unrelated, are not all bad or food hazards. On the contrary, we are making very good use of these in our daily lives. Some of them have a negative economic importance because they spoil food. From a safety point of view this is not really a problem (except economic) because we notice this due to the change they bring about in terms of smell, taste, colour, consistency etc.

The problem is the food hazard micro-organisms that can multiply on our food. They do not show. They are too small to be seen when the size of bacteria is in the 1µm range ($^1/_{1000}$ mm). Viruses, which are much smaller (about $^1/_{1000}$ of the size of bacteria) can be transported by food but CANNOT multiply on the food. It is bacteria and fungi which can multiply, and multiply very fast on some type of food. This type of food, we classify as HIGH-RISK FOOD. The infectious bacteria can multiply on the food and hence can spread to affect more people. These can be killed through cooking. On the other hand, the toxin producing bacteria will produce poisons which cannot always be removed by heat.

These multiply and multiply very fast. They are like tiny machines - very simple in form compared to higher organisms like man - but very lethal. They are possibly the only threat to humanity. Whether we like it or not, we humans must swallow our pride, and treat this group of organisms with a lot of care.

It is for this reason that we must take measures to keep their numbers down by chilling at <4°C or maintaining heat >63°C. Temperatures above 75°C will kill most of them. There are a number of these bacteria and each type has its optimum temperature for growth. On average, the most harmful bacteria will grow between 5°C and 63°C – a range which we call the DANGER ZONE. High-Risk Food **must** be kept outside this zone, before and after cooking.

Which are the High-Risk Foods? Well basically bacteria need water to grow. To this, add proteins and sugars and you have provided them with a most nutritious meal. Place them in their optimum temperature of growth and they start producing millions. They multiply at a remarkable rate. Foods which contain protein are meats, fish, seafood, soya protein, dairy products, egg products, cooked cereals especially rice, vegetable stock etc. Remove the water and they cannot grow. So if we dry milk through spray drying, the powdered milk does not need refrigeration. Same goes for dry uncooked pasta and rice, powdered eggs, soya protein granules, dry soup powders etc.

Our task as food handlers is to avoid letting bacteria increase in number and avoid spreading them around. Here is where the Traffic Lights System comes in handy. Red is like red paint - keep Red items away from Green READY-to-EAT foods. It is very important to use this logic for maintaining

the awareness AT ALL TIMES - in a food preparation area or in the manufacturing of GREEN food related accessories.

Hence, we must maintain RED zones and GREEN zones in food preparation areas, we must keep in mind the status of our hands, the tops, the utensils, the aprons/clothing and above all keep hazards like pests away from GREEN Ready-to-eat food. Hazards include ourselves, as we can be carriers of deadly bacteria that can spread to food. We are a huge reservoir of dangerous bacteria and viruses if we have diarrhoea or infected wounds/boils/whitlows/buttery eyes/sore throat, etc. Unfortunately, a very high percentage of us are carriers of these organisms which lay dormant in our bodies but given the right opportunity, will spread around like wildfire. It is for this reason that personal hygiene and hygiene are so important in the kitchen, food and food accessories areas.

For this reason, we must make sure that we are fully aware that there are RED foods and RED items in food preparation areas.

Raw meat and poultry, raw eggs, unpasteurized milk, non-potable water (e.g. water stored in open reservoirs), fruits and vegetables, pulses, dry fruit, raw cereals, spices and herbs, raw nuts and flour should all be considered RED unless we are assured otherwise. To this we must add HIGH RISK FOOD which is ready-to-eat but has been stored in the danger zone temperature. Ready-to-eat food which is HIGH RISK will lose its status of GREEN if left in the danger zone. These become a source of RED once left in the wrong temperature for a period of time to allow the multiplication of bacteria.

It is not just food items which are red but also things which find themselves in a kitchen like cardboard boxes, sacks, tins, buckets, cleaning tools, money, soiled moist kitchen cloths, mobile phones etc. To this list we must add flies, ants, cockroaches, mice etc.

Having said all this, one might think that biological hazards (NOT CHEMICAL) are easy to eliminate through heating up to 72˚C (+/- 5˚C safety margin). This would have been exactly the case had there not been the existence of SPORES in certain bacteria. These spores unfortunately can resist temperatures which are even higher than the boiling point of water i.e. 100˚C. This is only achieved through pressure cookers in canning factories where a temperature of 121˚C -135˚C can be reached. Frying oil temperature can reach 180˚C. Ovens cook from 150˚C to around 300˚C but the core temperature of the food rarely goes above 85˚C otherwise a product would dry up since water evaporates at 100˚C and turns into steam.

So, to make an analogy with a living plant, the plant will die but the seed will not. Hence, once the food starts to cool down and enters the danger zone, the spore germinates and starts multiplying once again if the food is of the HIGH-RISK type. A classical example is cooked rice. Cooked rice is very high in water and thus the surviving spores will multiply especially due to the presence of

Bacillus cereus. This is a toxin producing organism and thus reheating will not revert the status back to green.

Fungi follow the same pattern as bacteria but are more complex. "Luckily", most fungi manifest themselves on food and only cause spoilage. The dangerous ones are hard to detect and can produce carcinogenic substances which appear long after consumption of the contaminated food. Unfortunately, refrigeration does not always help but the most important is a dry environment since moisture is a necessity for these micro-organisms.

So, to reiterate, most bacteria and fungi need four elements to grow vis: -

1. **Water –** this is the reason why dehydrating food is a means of preserving them
2. **Temperature –** we already spoke of the danger zone i.e. 5˚C - 63˚C. Unfortunately, we have bacteria like *Listeria monocytogenes* which can grow at -1˚C. But keeping most food (except those that can support *L. monocytogenes)* outside the danger zone helps in keeping food poisoning bacteria under control
3. **Time –** Bacteria reproduce asexually in a very fast rate – in as little as 20 minutes if they have all the right conditions
4. **High Risk Food -** this is the food that allows the growth of bacteria.

A final note

These micro-organisms are becoming more and more significant, as we have the formation of superbugs and new emerging diseases like the avian flu. One cannot fail to reiterate how easy it is to spread these diseases through food since the customer lends us his trust. Maximum effort plus the right frame of mind and responsibility will reduce the risks to a minimum while setting both the producer's and consumer's mind at rest.

REMEMBER:

Develop a culture of being aware of your STATUS

CHAPTER 5 – Chemical Hazard & their role in Food Safety

Chemical hazards are substances which cause an adverse effect on the human body. The reaction can be immediate as in the case of poisons that cause vomiting, stomach pain and diarrhoea. Other chemical substances found in food can cause an allergic reaction. This will result in a rash, swollen face or tongue, shortness of breath, itching and related symptoms (see next Chapter – Allergens). Other allergic effects are those seen in the shellfish poisoning which include DSP – ASP – PSP, Diarrhoea, Amnesic & Paralytic Shellfish Poisoning respectively. In a worst-case scenario, these can bring about death! Chemical hazards can also cause long term effects like poison accumulation on body tissues as in the case of heavy metals and pesticides and in case of antibiotics the formation of resistant bacteria known as superbugs. In the future, since no antibiotics will be available for these bacteria, these can lead to death.

It is also possible for residues in the body to react with chemicals used for treating the human body. Unfortunately, the adverse effect that these cause, can be latent or effective after a very long time. Very few of these poisons are heat labile i.e. can be broken down during cooking, and it is safe to state that chemical hazards are irreversible. These often end up in the food by mistake, but sometimes they are added in a very irresponsible way. Food fraud is becoming a big concern and an easy target for criminals because food fraud is not given the same importance as other crimes like drugs. The Chinese melamine milk adulteration has shocked the industry, while the horsemeat scandal revealed to what extent people might irresponsibly act. This happened in Europe where a very rigid traceability law (EU 178/2002) has been in place since 2005. (see Chapters on traceability and EU Legislations)

More laws have been put in place to ensure that the additives that are added to food are the ones found in the EU Law 1830 of 2003, Regulation 1333 of 2008 and the Codex Standards. Detailed specifications of these additives exist and some ingredients have to be accompanied by a warning on the packaging. The EFSA (European Food Safety Authority) is also studying the long-term effect of the ACCEPTED CHEMICALS. We will see these later in the Solutions Section and the Laws/Standards.

It is here that one cannot fail to emphasize the importance of the food handler. The food handler must be fully aware of these dangers, especially those resulting from bacterial and fungal toxins. These increase fairly rapidly when leaving high risk foods to stand within the Danger Zone for an unnecessary period of time. These micro-organisms will continue to increase, together with the toxins they produce. Unfortunately, we must be extra careful to cater for the consumers' abuse and hence make sure to keep their numbers to a minimum. This is even a very bigger problem in a warm environment, warm countries and kitchens. As stated previously, the cooking process will kill the vegetative cells (not spores) but will not eliminate the poisons.

There is a general misconception that heat will eliminate all problems. CHEMICAL AND PHYSICAL HAZARDS ARE IRREVERSIBLE

One particular case of heat causing even more problems, is the overuse of frying oil. The byproducts of overused oil are now listed as substances that bring about cancer. (see Solutions)

Excessive heat also produces chemicals like acrylamides in starch-based foods like overbrowned potatoes after cooking. Also, chemicals like dioxins are finding their way into our foods.

One final heat resistant "chemical" that cannot be forgotten is the PRIONS. Prions are nonliving protein elements – which are not affected by heat – that cause a sad and miserable condition of the brain. If it ends up in the brain cells, the cells will somehow start using all their resources to make copies of this protein resulting in cell death. These proteins increase in number and spread in the brain turning the brain into a sponge like mass. This is a condition which leads to death known as Creutzfeldt–Jakob disease – one of the new emerging diseases mentioned earlier.

This chapter cannot be complete without mentioning the "allergic" type of reaction caused by a class of toxins produced by a number of families of fish. This is the Scombroid Group. Generally speaking, fish are very good indicators of freshness. Unfortunately, the formation of these toxins, comes before the stinking indication of fish. The group includes the tuna family, mahi mahi (or Dorado) and sardine/anchovy family. The poison causes the famous Pirate's rash. Although fish is listed as an allergen (c/f next chapter), this poison has no selected groups but it affects anyone who consumes fish that have not been stored at the right temperature thus forming this scombroid toxin.

Toxins are not something new in fish, as we come across a number of fish which have parts of their tissues that can store some very dangerous poisons. This is due to the accumulation of poisonous elements in their diet which they fail to excrete. One notorious species which fetches a high price in the Far East, is the Puffer fish. There are a number of poisonous fish, but most fishermen know these species very well and hopefully they do not land these on the market. Fishermen are food handlers too and should be aware of their processes.

Since we are still on the subject of fish, large pelagic fish are also known to accumulate mercury. Mercury is a very heavy liquid metal which is used in the manufacture of thermometers and float switches. For this reason, mercury thermometers are banned in food preparation areas (together with the physical hazard of broken glass). But high consumption of these large fish like swordfish, shark and tuna, causes elevated levels of this heavy metal in our body tissue. These large fish, which are found at the top of the food pyramid, have a very high food conversion ratio, sometimes

reaching 20. This means that they eat 20kg of fish to produce 1kg of their own muscle tissue. Since mercury, found in polluted seas, is not excreted by these large fish, it ends up accumulated in their muscles.

Another heavy metal which is very poisonous is lead. The Romans knew quite well its effect since this metal was used to manufacture their water pipes. But lead used to be an additive in car oils, paints and in printing. These could end up in food if used as a fuel in ovens. Newspapers used to be commonly used for wrapping fish and chips many a time, coming in direct contact with the green R-T-E food! It is also important to use food-grade paint in food preparation areas, as these can contain poisonous lead in other forms. (see solutions)

Apart from fish, we also have to mention poisonous plants and mushrooms. There are a few "plants" that might accidentally end up in the kitchen which are highly poisonous. Several highly toxic wild mushrooms are simply lethal. One should not take any chances if the species is not the common familiar type. The list of poisonous plants is very long but the only one that one cannot fail to mention is the extract of red kidney beans. It is very important to discard the water that red kidney beans are soaked in and that was used to boil the same beans. These toxins are naturally found in the plant but a lot of other toxins can end up in the plants and meat due to bad agricultural and husbandry practices. One of the most notorious is dioxin, a chemical byproduct which is known for its cancer producing character. It can be absorbed by plants, eaten by animals especially grazing animals and even egg laying chicken. The dioxin ends up in the beef, milk and eggs respectively.

- **Chemicals added to food**

These are chemicals which are added to food as an additive, either to protect it or to enhance it. Getting to know which are those chemicals that are harmful, may not be easy and one should not add any form of chemicals without adding this to the label. EU Regulation 1333 of 2008 lists the permitted additives. One must also make sure that this is food grade and does not exceed the prescribed limits. Some chemicals e.g. colour E110, E104, E102, E122, E124 and E129, can be used in low quantities but must be accompanied by a statement on the label "May have an adverse effect on activity and attention in children." Such additions MUST be strictly regulated as there are groups of people who do not wish to ingest anything that is not natural. And not all the natural extracts are harmless. Certain groups of people do not want to ingest anything without a pre-advice. This includes GMOs (Genetically Modified Organisms) and irradiated products. There is also the presence of unwanted substances other than those produced by vegetables which include residues of pesticides and antibiotics/hormones. These can be present even inside the plant due to the type of irrigation water used. This applies too to fisheries and aquatic species as these may contain traces of unwanted substances in the final product. It is up to the person making the purchase to ensure that raw materials are accompanied by certificates of analysis. Consumers' requirements and wishes must be respected and definitely not abused.

Chapter 6 - The Allergens and other allergy causing Chemicals

The symptoms of an allergic attack have already been mentioned in the previous chapter. We have also mentioned the fish that produce the scombroid poisons that bring about an allergic attack to ***everyone.*** But there are a group of food items which are completely harmless to most people, which can cause a severe allergen attack to others – these are called allergens.

One must understand that even a very small amount of these substances (20 parts per million) can cause very severe effects on some people. We must be aware of these substances and avoid cross-contamination if we use them for other foods. We also must declare their presence in the food and avoid declaring their absence if we are not 100% sure of their absence. Their presence must be highlighted on the product label according to EU regulation 1169 of 2011. There are about 100 products that cause some form of allergy but, the listed 14, cause 90% of the cases and thus deemed important to list by the same law.

Although the law lists 14 types of these foods, some people are sensitive to some other 85 items. We must make sure that we list all the ingredients both on packaging, menus or other information attached to the particular food product. (in a prominent font e.g. bold or underlined), The lists consist of: -

a) Nuts

When we say nuts, it is not just the whole nuts but also their extracts, crushed powder nuts, oils etc. These include almonds, hazelnuts, walnuts, pecans, chestnuts, macadamia, pistachios, cashew nuts and brazil nuts. Some sources also quote coconuts (if used, there is no harm in highlighting its presence).

b) Peanuts

Peanuts do not grow on trees and sufferers of this food item are not necessarily sensitive to the other nuts.

c) Cereals containing gluten, namely: rye, wheat, barley, oats, spelt, kamut

d) Crustaceans and their products. These include shrimps, prawns, angustini, crab, lobster and other sea animals that carry a “hard” exoskeleton

e) Eggs and their products

f) Fish and their products. Here we are not just mentioning the scombroid producing fish

g) Soybeans and their products

h) Milk and dairy products

i) Celery and products thereof

j) Mustard and products thereof

k) Sesame seeds and products thereof

l) Lupins and products thereof

m) Molluscs and products thereof e.g. mussels

n) Sulphur dioxide and sulphite – this is a chemical used to disinfect wine bottles, used in the crushing of grapes and to preserve crustaceans like shrimps after capture

Chapter 7 – More about the Traffic Lights System

What do Traffic Lights have to do with a food safety course? Well, traffic lights are something that everyone knows and understands. It is something easy to remember. It is a system based on common sense rather than having to remember a lot of rules. IT IS ABOUT AWARENESS.

In a kitchen, one must be *aware* of the dangers. Hazards are not just the domain of the HACCP Team. EVERYONE HAS A ROLE TO PLAY. We must get accustomed to seeing things as either RED or GREEN. We will discuss the amber colour later.

RED is about DANGER, STOP. In a food preparation environment (this applies also to accessories like packing material, lubricants, air, water, inks, detergents, etc.) there are a lot of RED items which HAVE to be in a food preparation area. This colour has a particular characteristic. It is like WET paint – whatever touches the red, turns into RED. In scientific terms, we call this CROSS-CONTAMINATION. A lot of people use the terms DIRTY. Being DIRTY does not necessarily implement RED. A very clear example is clean hands. Many times, we have clean hands but in reality, they are RED. Similarly, a plate which has just been used for gravy may appear dirty but in fact is still green as it contains RTE food (ready-to-eat).

So, all RTE food MUST be GREEN. So must the utensils. We must keep red and green separate – to repeat – as everything that touches with RED becomes RED. We reiterate our saying that "*Red and green together should never be seen.*"

This awareness is very important. It has to become part of the software of the brain of every person working in a food preparation environment. Cleaning, disinfecting and sanitizing is a way to revert surfaces and our hands back to a GREEN status.

There is a lot of food that is classified as dangerous i.e. RED. This includes: -

- Raw meat including poultry and game
- Raw vegetables and fruits
- Cereals like uncooked rice and pasta
- Flours and uncooked dough
- Spices and herbs
- Raw eggs
- Unpasteurized milk
- Lentils and Pulses
- Raw nuts
- Dried fruits

- And finally – HIGH RISK food which has been left at a convenient temperature for bacteria to multiply. We will call this the danger zone which is from $5^{\circ}C$ - $63^{\circ}C$.

We will deal more about bacteria later on, but this special group of organisms will very happily multiply if HIGH RISK FOOD is left in the danger zone.

HIGH RISK FOODS are: -

- EGGS
- MEAT and FISH
- SEAFOOD and SNAILS
- Reconstituted High Protein products like Soya Protein
- Milk and Dairy Products especially soft cheese dips
- Cooked Pasta and Rice
- Soaked Cereal
- Processed Fruits and Vegetables sauces and dips

All these items MUST be left or stored outside the danger zone either in a FRIDGE (1°C - 4°C) or FREEZER (18°C - 22°C) or in a HOT CABINET (>63°C).

What colour do we assign to HIGH RISK FOOD? It depends. If we are talking on a nice grilled fillet steak coming straight out from the grill – this is an RTE food and is then GREEN. But if this is left in the DANGER ZONE overnight, then it will change the status to RED and cannot be reversed back. So, a raw piece of fillet will have a RED status. Cooking it will kill the bacteria present on the outside to turn it to GREEN. So unlike R-T-E food (GREEN) and DANGEROUS GOODS (RED) we can only assign the colour depending on the status of the particular H-R-F (high risk food). A short note on undercooked meat (rare) – this MUST be coming from meat that has been inspected for parasites. This applies also to undercooked fish and its use in carpaccio's and sushi. Fish can contain a very dangerous parasite e.g. *Anisakis.* This is a killer and must be eliminated through a freezing step of the fish for 24 hours prior to use. Freezing has NO EFFECT on bacteria and mould but eliminates the parasites.

What about AMBER, the third colour in the traffic lights? We will get to use it later on.

CHAPTER 8 – Processes, Flow Charts & Process Models

This chapter describes what is a process. Whatever one does in life is a process. Food handlers take part in a process which they must fully understand and own. To produce safe food, the handler MUST ensure that this becomes part of the software of his brain. This is simplified through learning how to draw a process model (as seen below).

A process is defined as an *activity which has in input and a different output.* Most of the things we do in our daily life is a process. The scope of this chapter is to find out how to draw a process model. Drawing a process model is a very good tool for improvement. Every process is unique and drawing it helps us to evaluate things that are sometimes taken for granted.

Let us consider a very simple process which we do on a daily basis – getting out of bed and dressing up for work. Consider the diagram below:-

From bed → to work

This is a daily routine. Everyone has his version of this process and this diagram represents the change from the minute we wake up right until we are ready to have our breakfast – another process – before going to work. The pictures above only show the input and the output. What we have now to consider are the countless inputs and outputs which make the process happen. We do not even think of them. These include: -

Inputs

a) An alarm clock
b) A bathroom and hot water
c) A toilet and toilet paper
d) Soap
e) Clean water
f) Clean towel
g) Toothpaste and toothbrush
h) Light
i) Mirror
j) Shaving foam & razor (male)
k) Make-up (female)
l) Face cloth
m) Clean underwear…….. *and much more!!*

OUTPUTS

a) Wastewater
b) Dirty towels
c) Dirty underwear …… *etc.*

We can include these in our process model by making more labeled arrows going in and those going out. Now, don't we normally write these down in our lives? I have never come across someone with a checklist which he/she ticks every day. ***It is because it has become part of the software of our brains***. At some point, someone trained us to do this. This is why TRAINING for COMPETENCE is so important to all food handlers. And besides, the most important thing is to OWN it and IMPROVE it. Each person is a champion of his/her process/es. It is his responsibility to ensure that there are NO hazards in their INPUT.

In reality, errors during food manufacturing happen because we do not make these parts of our software. Learning how to work in a food industry is *tacit* knowledge. Tacit knowledge is that knowledge which requires shoulder rubbing and detailed monitoring. This CANNOT be learnt from a book – try learning how to swim or drive a bike from a set of instructions! Such skills, once learnt, become part of the software of our brains. This book focuses on the awareness and pitfalls that can occur in the food industry – which unfortunately can lead to highly undesirable results – which could be fatal or have a long-term adverse effect on our consumers. A small mistake can change a person's life! This is what we term as the *attitude* of our work practice. We must fully understand not just the knowledge (the What) and the skills (the How) but also the Attitude and the Why we do things. We owe this to our end consumers. In the end, it builds the trust that the food industry has. After all, we are ALL consumers of other food handlers' food! We are just a

small part of the “food chain”. Just think how many people are involved in preparing the food we need for our daily living. If one of these is irresponsible, this will have grave consequences on us, our families and friends.

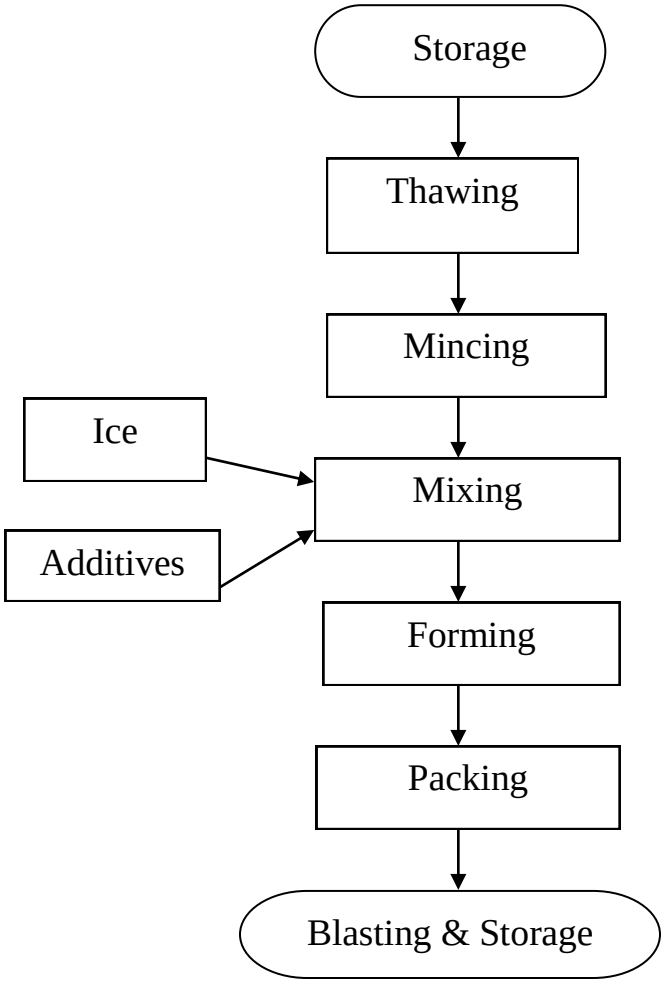
In the next chapters, we will be discussing the tools to make our processes safe. Not only that, but we must seek ways of making things FAIL SAFE. This means besides the training and the awareness; we must be proactive and plan things in a way that FAILURE IS HIGHLY IMPOSSIBLE. Each food handler must do some thinking during his drawing of his process to ensure that it is almost impossible that his process fails. It is for this reason that we have introduced the Traffic Lights System. We must think RED (DANGER / HAZARDS) and GREEN (SAFE). This is the basis of HACCP! HACCP (fully explained later) is not just the domain of the HACCP Team. It is everyone’s responsibility.

So as once can see, in the food industry, workers must bring their brains along with their hands. The food industry is not made up only of RULES but mostly of common sense and RESPONSIBILITY. After all, we are directly responsible of what we do.

The outputs of processes are the inputs of the next process. This forms a system. We normally draw this in the form of a Flow Chart (for HACCP purposes). Again, drawing flow charts, and understanding what they mean, is a pictorial explanation of what goes on in the food industry. One main reason is that we must demonstrate DUE DILIGENCE if something happens. We must show that we did our best by being PROACTIVE in our planning of the processes. These are very good tools for planning our HACCP. Implementation of HACCP (meaning Hazard Analysis Critical Control Points) is now a legal obligation in many countries and so every food handler must not only be aware of it but also participate actively and with full responsibility. This is mentioned in EU Regulation 852 of 2004 Section 1 point 13 - “*Successful implementation of the procedures based on the HACCP principles will require the full cooperation and commitment of food business employees. To this end, employees should undergo training. The HACCP system is an instrument to help food business operators attain a higher standard of food safety. The HACCP system should not be regarded as a method of self-regulation and should not replace official controls”*.

Below is an example of a flowchart: -

Beef Burger Manufacturing: -

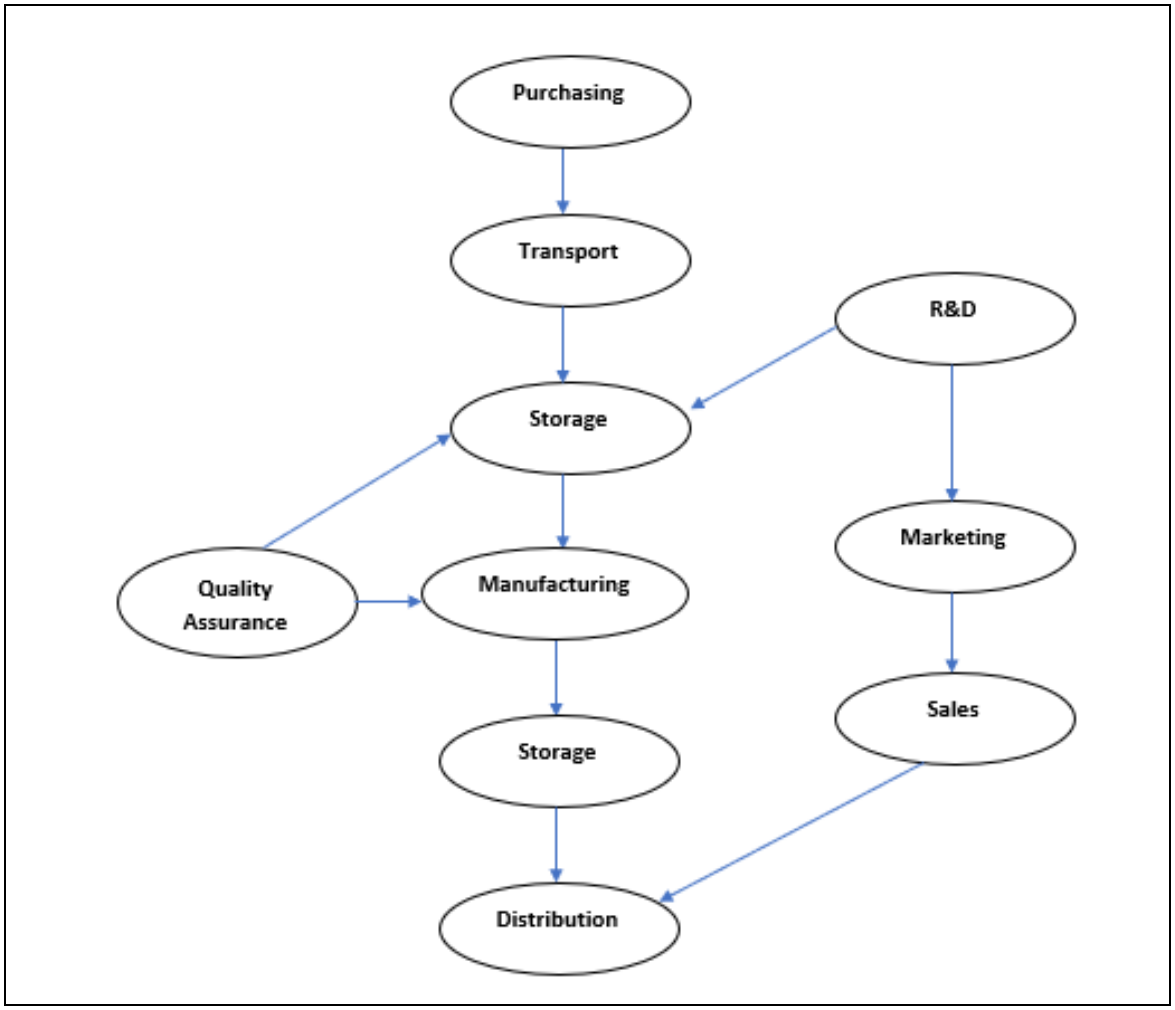


Later on, we will describe how we use the Traffic Lights System to colour-code our Process Plans, our Flow Charts and our Hazard Analysis/Plans. This is based on a risk assessment of each step.

- **Process Models**

The previous example was that of a flow chart. In reality, this is a series of processes in itself and, in many companies, these are owned by different workers. Process owners must ensure that they work in liaison with the next process owner and his previous one i.e. his supplier.

Processes can be mapped into a system of processes and in one process can have more than one process as an output which in themselves turn out to be the inputs of other processes. A general company systems map may look as seen below: -



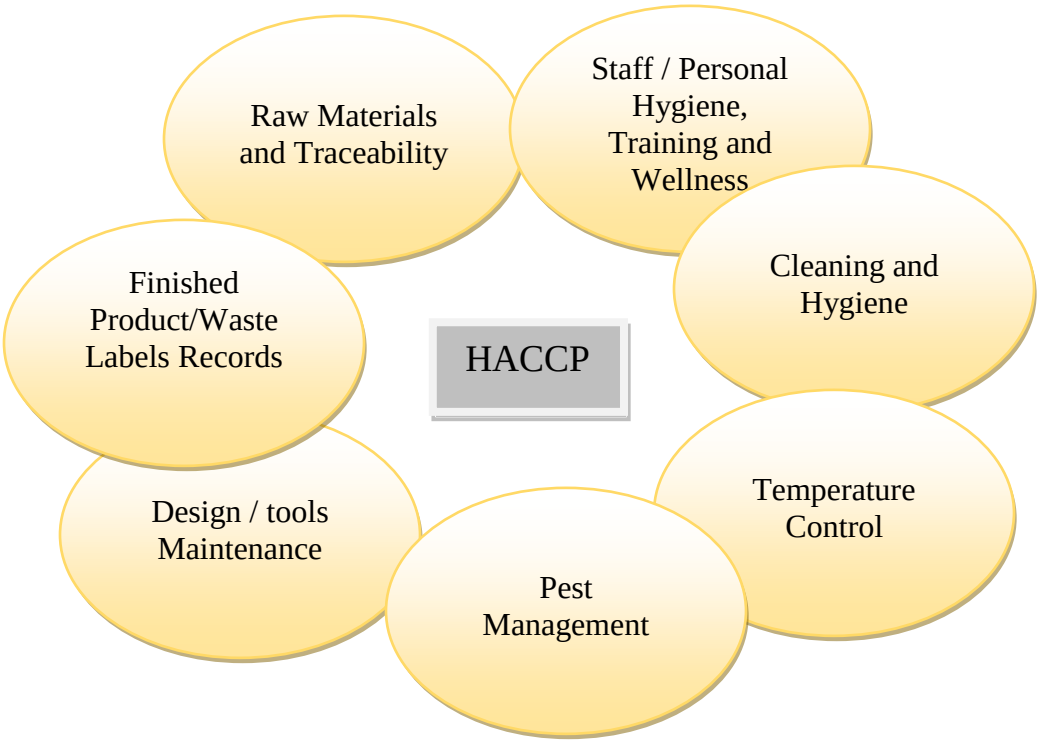
This shows a simplified schematic diagram of a small operation. Each process is made up of processes. This diagram is a very important tool for planning and ownership of the processes.

To conclude - a note on documentation. Keeping records is important as it proves due diligence in case of any food poisoning occurrence. This is also included in one of the principles of HACCP.

One final note about processes. Inputs and outputs can be tangible and non-tangible. For example, an ingredient is a tangible input while training is a non-tangible input which is very important. These can be measured. In quality, we say “what is measured can be improved”. A successful organization is one where ALL its employees own their process and are trying continuously to improve it.

Chapter 9 – Solutions

In the previous chapters, we have spoken about Problems. It is about time we start speaking of Solutions. We discussed one major important tool, and this is process mapping. The main approach is to adopt a proactive approach. I always say that the pillars of producing safe food are:-



These seven pillars, or links, are very important to produce safe food. If one of them fails, the system breaks down and we can produce food that is not safe to consume. In the center of this diagram, lies the HACCP.

One important aspect is RECORDS. In case the system fails, hoping it is robust enough through everyone's input, then we can prove due diligence. Records must be done in a way as to be a tool rather than a cumbersome exercise. Records are not just needed for traceability but also for accountability. Luckily today, we have electronic tools which can make our lives easier and less stressful. These "pillars" or "links" are also labelled as the pre-requisites of HACCP. Their degree of complexity depends on their influence or the quality (including safety) of the finished products. They are based on a Risk Assessment. So, let us discuss the content of each link.

- **Raw Materials**

The quality of the finished food depends on the quality of the raw materials. One must establish a good rapport with his/her supplier who in turn must treat us as a loyal customer. Assessing the supplier is a very important issue whether we are just purchasing our ingredients for a small

restaurant to purchasing materials in bulk for a large company. Buying raw materials from the market for a small restaurant can be based on trust but this must not be taken for granted. In large companies, purchasing is a detailed issue with assurances made through purchasing from certified suppliers, requesting of certificates of analysis and above all ensuring that the product is well labelled and has a lot number, use by/best before date. These must be accompanied by signed declarations especially indicating allergens, GMOs, additives, irradiation and other information that must be declared on the final label. In Europe, chemical additives must comply with EU Regulation 1333 of 2008.

Many think that raw materials are just the edible ingredients. But these also include: -

1. Wate*r* - when used as an ingredient or for washing, water must be potable and in accordance to the regulation of the country. The EU has its own directive, 98/83/EC and depending on the risk, this must be tested regularly.

2. Detergents – These must be food grade and accompanied by a certificate of analysis stating that it does not contain chemicals that are harmful to humans.

3. Air - this could be a source of contamination especially if it is a direct ingredient as for example in ice-cream manufacturing.

4. Packaging – One of the most important aspects in the packaging is that it is food grade and manufactured with a GMP (Good Manufacturing Practice) suitable for the food industry. However, one must also get a certificate that the wrapping is suitable for the content and does not leach in the final product. The user must inform the supplier about the content and storage temperature.

5. Lubricants – These too must be food grade as they can finish in the final product

6. Inks and paints used in the packaging – These must be food grade since most packaging comes in rolls and the inside of the pack is in contact with the outside which is normally printed.

○ **Staff**

Of all the inputs in any process, this is possibly the hardest to control and this is why this book has been written. If even one single person inputs a hazard in the system, the whole chain fails. Someone out there will suffer. Staff must be fully aware of their responsibilities towards the law and the basic ethics of life. They must participate in HACCP and fill the necessary records. Staff must own the process and work to improve it by working smarter but not necessarily harder. They should be aware of their personal hygiene and obeying company rules. If staff are suffering from a disease that can be spread by the food, then they are obliged to inform their direct supervisor about such conditions. This includes jaundice, diarrhoea, vomiting, fever, sore throat with fever, infected skin lesions e.g. boils, whitlows and discharge from ears, nose and throat. Staff should draw their own process and make sure no hazards enter the system. They must make sure that they are COMPETENT in what they are doing.

REMINDER – Hazards are RED – Red & Green together should never be seen!

Visitors and subcontracted workers must be closely monitored if they enter the production area during manufacturing. These should be made to sign a visitors' book where they declare that they are not sick or have any form of disease which can be transmitted by the food.

○ Pest Control

Pests are vectors of bacteria and other biological hazards. They can even die in the product and transfer the poison that they would have ingested. These pests are not very discreet, and they leave footprint marks on soft/greasy products, holes, body marks on walls, their excretions, abnormal odors, body parts and fly/ant infestation. So, pest management does not only mean seeing the actual pest but also their trail. One must also include birds, dogs, cats and other pets. These are normally carriers of *Salmonella* – and should NOT be allowed in the food preparation area.

What is the solution? Foods must be kept in closed containers and windows are fitted with wire netting. Doors and windows should be pest proof and gaps under doors are secured by rubber linings to avoid ingress of pests. It is wise to have a knowledgeable pest partner who sets several monitors to assure that no pests find their way in the production area. A useful tool is to have the pest partners draw a pest plan indicating all controls related to pests. It is also important to monitor also the parameter of the place to ensure that these are eliminated before they find themselves in the food preparation/storage areas. It is wise to keep a pest activity chart and write down any observations and the corrective action taken and the preventive action to be taken. Pest monitors for insect activity are also important where grains and flours are used.

○ Cleaning and Hygiene

Personal hygiene is very important and emphasized in the staff section. Cleaning is a process which turns things from dirty to clean, therefore from Red to Green. Special care should be taken especially where surfaces come in contact with R-T-E food. The following is the recommended five step cleaning method:-

1. Physically remove large debris using a "green" hard brush or vacuum-cleaner
2. Wash with food grade detergent
3. Rinse with potable water
4. Disinfect with a food grade disinfectant
5. Rinse with potable water

Cleaning must be validated in a laboratory and verified regularly especially if surfaces come in contact with R-T-E food. Once the method has been validated, one must maintain the same conditions vis:-

1. The product type
2. The temperature
3. The dilution
4. The contact time
5. The degree of soiling

If any of the above change, then validation must be repeated. The above must be included in the cleaning schedule and a cleaning record is signed by the person who does the task.

One must ensure that cleaning materials used in food preparation areas are best to be unscented. One must choose the right type of detergent and disinfectant for the job. These cannot be mixed as most of them interact. When cationic surfactants are mixed with anionic and bleach (sodium or calcium hypochlorite) these are very easily neutralized with organic materials. Bleach is very effective on clean materials and if it is a nonfood contact surface, this can be left on, as the activity of this product is a product of time and concentration i.e. a low concentration for a long period has the same effect as a short period with a high concentration. Hypochlorite is cheap and is effective against a wide range of organisms. In high concentrations (>400ppm) it tends to darken stainless steel and corrodes aluminium surfaces.

One can clean as one works – commonly referred to as clean-as-you-go. One can also utilize CIP or cleaning-in-place for large ovens/machines and reservoirs/piping etc. Colour coding cleaning tools and cleaning chemicals makes life easier for the owners of the cleaning process. The below is an example of a Cleaning Schedule.

ABC Food Manufacturers Cleaning Schedule

Area: _____

Job	Method	Frequency	Health and safety	Mon	Tue	Wed	Thur	Fri	Sat	Sun

Method	Health & Safety	Concentration	Instructions for method
A			
B			
C			
D			
E			

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- **Temperature control**

From all the three hazards, it is only biological hazards that can be converted from Red to Green by heating to >75°C. The danger zone applies to organisms which are harmful – we call these pathogens. As clearly stated in the chemical hazards, toxins produced by bacteria are not always destroyed by heat. We quote 5°C-63°C but *Listeria monocytogens* can grow even at -1°C. Hence the multiplication of this organism is not necessarily stopped in the fridge i.e. a temperature of 1°C - 4°C. This is why this organism cannot be present in foods especially dips, soft cheeses, etc. but lately this was found in frozen vegetables and was consequently recalled to avoid the presence of this organism in a product which was blanched prior to packing and deemed safe i.e. GREEN.

Refrigerator temperature should be 1°C - 4°C and even the product's temperature must be 1°C - 4°C. Displays with cold water underneath (in the lower compartments) normally display a temperature of 1°C but these are not always capable of maintaining such a temperature for the product. In other words, these are not strong enough to cool but only to keep cool. Ideally products placed inside should already be cooled i.e. MUST be coming from the fridge. Similarly, hot displays must be >63°C if one wants to stop the multiplication of bacteria. If this is lower for more than 4 hours, one must carry out a Risk Assessment and discard food with a high-water content after validation of the process. Again, hot display cabinets are not meant to heat products but to keep them warm.

Temperature control is a critical point because it can change. Hence, it is very important to monitor fridge/freezer temperatures regularly i.e. morning and afternoon and someone MUST be responsible for the monitoring and recording. In case this goes out of control, there must be a corrective action. The HACCP team must decide on this based on the risk assessments.

In certain meat preparation areas, the temperature of the meat, fish and products of animal origin (e.g. cheese), must be kept below 6°C and offals at 3°C (EU regulation 853/2004). The recommended ambient temperature to maintain these temperatures is 12 °C.

Cooking temperature MUST exceed 75°C in the core especially in chicken, since poultry and game having *Salmonella* in their blood stream, do not always show signs of disease unlike mammals like pigs, cows, sheep and horses. So, blood on your chicken means bacteria on your plate, if the chicken had *Salmonella* in its bloodstream. It is not safe to eat the poultry with blood. The cooking temperature is also important where mince is involved and so the bacterial load is high. This is a critical control point and a simple document with the signature of the person monitoring the system must be maintained.

Pasteurization is a temperature-dependent process where the product is heated to a high temperature and cooled. Various products have different temperatures, depending on the nature of the product and the bacterium one is trying to eliminate.

○ Thawing and refreezing

If products are made from frozen meat, this should be included on the label together with the country of origin and the correct animal species. Thawing should be only carried out at a temperature of 4°C. Thawing in a microwave oven is not recommended in an industrial setting as heating is very uneven. Thawing at room temperature or warm water is a big NO as most bacteria are on the outside and it is the outside that thaws first, hence the multiplication of bacteria, something we do not want even though the product will be cooked. Toxin producers will be killed but not their poisons. The only alternative in an emergency is COLD RUNNING water for not more than 20 minutes, but this is only in an emergency.

Is thawing and refreezing dangerous? From our experience, if the product is thawed at a temperature of 4°C for a day, refreezing in a domestic refrigerator will bring about formation of water crystals which in turn are lost from the 2nd thawing. As a result, there is a drop in the quality of the product and thus this is not recommended. Blast freezing, is a process where cooling is carried out rapidly giving no time to the formation of expanded ice-crystals. Blast freezing is a good way not only to avoid bacterial growth but also as an issue of quality.

During the recording of the temperature display, one must always check the temperature of the products inside against the temperature of the display. Also, large cold storage rooms should be "qualified" by taking the temperature at various points of the fridge/freezer when loaded to assure that the temperature is constant in different spots of the unit. The temperature display should be regularly tested against a certified thermometer to calibrate the display if necessary, twice a year. Nowadays, most cooled chambers are fitted with a data tracker which takes the temperature and transmits it to a PC. These are normally set with an upper and lower limit and sends a signal to a preset number, that the chill chain has been lost. These too must be validated regularly by turning off the chiller power and see if the alarm is set. This is recorded as a test in the temperature records.

○ Maintenance and design

The layout of any food producing area must be designed in a logical way that separates the RED activities from the GREEN ones. This is not always possible due to the size of certain small kitchens. The separation can also be in time (referred to as temporary separation) i.e. the cleaning of fruit and vegetables can be followed by eggs, pastry, meat etc. – all RED. After cleaning and sanitization, one can do the GREEN activities and store in the fridge.

The GREEN items should be placed away from the RED items. Hence the latter should be placed below. Thawing too should be carried out in the low shelves, to avoid cross-contamination. Ideally, a fridge should be either GREEN or RED to avoid cross-contamination. Industrial fridges store different classes of food in different areas.

○ Maintenance of machines

A prerequisite of HACCP is also the good functioning of tools and machines. A maintenance schedule should be in place and a record of the repairs of anything that breaks must be noted down. The schedule is to be adjusted accordingly to cover preventive maintenance adjustments.

○ Designing for prevention

Certain design features are meant to be preventive. Examples are colour coded chopping boards and plastic-coated lighting units, just to mention a few. One must ensure that such features promote safe food. The design should be in a way to facilitate cleaning and to avoid accumulation of dust and particles. Surfaces should be nontoxic, do not absorb water and do not hold water. They should be hard to scratch as scratch marks tend to fill up with bacteria and become difficult to clean. This applies also to coving where surfaces meet to avoid the accumulation of dust/dirt. If the use of glass is a must, there must be a glass policy, whereby an inventory of glass items are kept and checked regularly by someone who is responsible for the task. Glass used for windows should be shatterproof while light bulbs/tubes should be covered in plastic to avoid contaminating the food with any glass fragments in case of an accident.

Water is a very important ingredient and water reservoirs should be well protected, made from food grade material which is light-tight to avoid formation of algae or entering of insects, birds, etc. Water systems should be fitted with metal taps that can be flamed so that water sampling is facilitated. These are best marked with a number for record keeping.

○ Finished product

The finished product must be well stored and cared for. It must be well labelled. In Europe, there is the EU Regulation 1169 of 2011 and each country has its specific labelling additions. It is very clear that the law states that the label must give as much information as possible. It must have the nutritional values per 100g, the allergens clearly written in bold, and the ingredients listed in a descending order. Vegetable oils must be specified as to which plant it originates from and permitted chemicals, written either as an E number or the full name, must be preceded with the function. There must also be a postal address and contact number. If the name of the finished product contains an ingredient (e.g. chicken pie) the % amount of chicken must be indicated in the ingredients list. A lot number and a best before date/use by is also a must for traceability purposes. Storage should always follow the FIFO (first-in-first-out) method, whereby the latest product is always placed at the back so that the “oldest” product is used first.

- **Traceability**

EU Regulation 178 of 2002 states that all finished products must be traceable to the original ingredients' batch number. This is a simple thing with today's computer systems as long as one enters the right data. The issue becomes more complex if one uses "rework" ingredients. This means that one is able to state from which batches a particular product has been made. One must devise the easiest way to record where the raw materials have been used i.e. in which final product.

- **Waste**

Waste is also a finished product and although not necessarily RED, one must make sure that this is not mixed with the finished product. In Europe, all meat byproducts must be recorded and disposed and have a certificate to show where this product has ended.

HACCP

HACCP stands for Hazard Analysis of Critical Control Points. It is a proactive system whereby one tries to carry out a Risk Assessment on whenever there is a risk that a HAZARD can occur. If this is the case, then a critical limit is found and monitored. One also has to establish corrective action. All this must be recorded and verified.

There is no one simple correct way on how to carry out HACCP. The Codex Alimentarius is the body that first officially turned HACCP as a part of a code of practice (Code of Practice for General Food Hygiene 2003). This same code recommends thirteen steps on how to achieve these seven principles which are:-

1. Conduct a Hazard Analysis
2. Identify the Critical Points
3. Establish Critical Limits
4. Monitor the Critical Control Points
5. Establish Corrective Action
6. Verify that the system works and that it is under control
7. Record the points related to the monitoring or any other control measure

Look at the process model below. It is that of roasting a chicken.

This is a process model. Let us start by considering the inputs:-

- ✓ The chicken (red)
- ✓ The heat source (green)
- ✓ Water (green)
- ✓ The container/receptacle (green)
- ✓ The spices/herbs (green)
- ✓ Other ingredients (green)
- ✓ A thermometer with probe (green)
- ✓ A basin to rinse gently if necessary (green)

The output must be GREEN:-

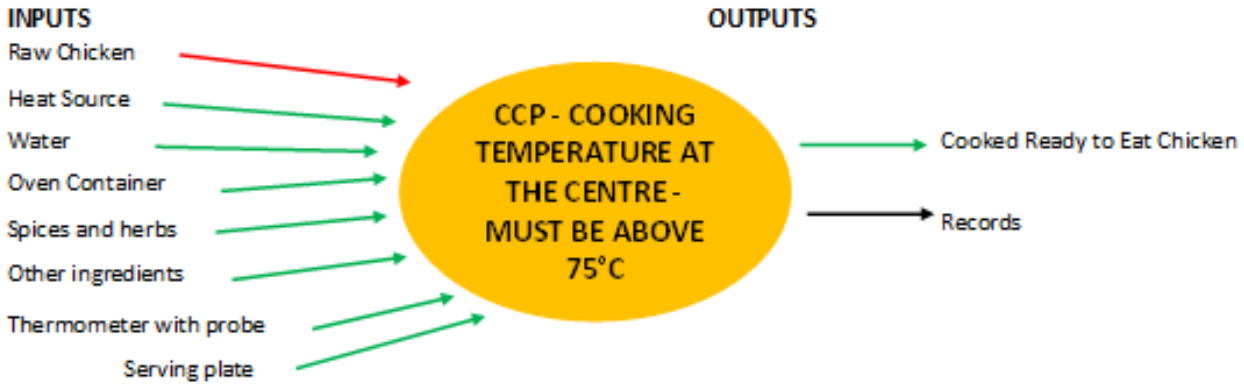
- ✓ Cooked chicken which is ready-to-eat
- ✓ Records

Now, the critical point is the cooking temperature at the core. This must be above 75°C.

For this reason, the circle in the middle takes the amber colour and there must be a record signed showing that the temperature is being reached. It is beyond the scope of this book, to explain in detail how this is done but in the following chapter, there is detailed Hazard Analysis Sheet and a HACCP Plan signed by the HACCP team, the person who will be monitoring and the person who verifies the monitoring.

A strong HACCP team is made up of people having different expertise. If the company does not have any, it should source experienced and trained experts as recommended in the Codex Alimentarius.

A process model for the cooking of a chicken



Once this is ready, it must be either: -

- Served immediately
- Blast frozen or chilled and kept at 1°C – 4°C
- Placed in a hot cabinet at >63°C

Chapter 10 – My Process

Each person working in the food industry must understand his responsibilities. There are not only laws which must be obeyed, but one has also got to respect the basic ethics of life towards our fellow humans.

We must become champions of our process/es. Even if you have a very small part of the whole system – your input is very important. If you fail, THE WHOLE SYSTEM FAILS. You must be aware of your inputs and outputs and the status of your hands, tools, apron, machines, surfaces, etc. One also must keep in mind the temperature of the raw material if this is High Risk (i.e. bacteria grows on it). In such cases, one must ensure that the temperature of the raw material does not go beyond 6°C as this increases the number of bacteria in the raw material we use. We must look at things with a lot of awareness.

Let us take the case of the flow chart which represents the manufacturing of beef burgers. You might be the owner of the complete operation or you might have just a single step e.g. adding of ice for the scope of keeping the mix cool and so melted ice is not good. Ice is made of potable water and hence is Green. You must handle it with Green tools. If you touch them with a Red hand or Red tools the ice turns Red. Remember "Red and Green together should not be seen".

As in the case of the previous chapter process, we use of Amber in the Traffic Light Systems. If by making a risk assessment there is a chance that a process can go out of control, then this step MUST be monitored, as it is a critical control point. The person responsible for the monitoring of the Critical Control Point must ensure that he/she records the step and takes the action indicated in the HACCP plan if it goes out of control. As a reminder, we print the HACCP plan on an orange sheet. It reminds us that this is a point that MUST be monitored.

After identifying the hazards, then decide their critical limit as mentioned in page 27 in the Recommended Code of Practice for General Hygiene 4-2003 https://www.mhlw.go.jp/english/topics/importedfoods/guideline/dl/04.pdf

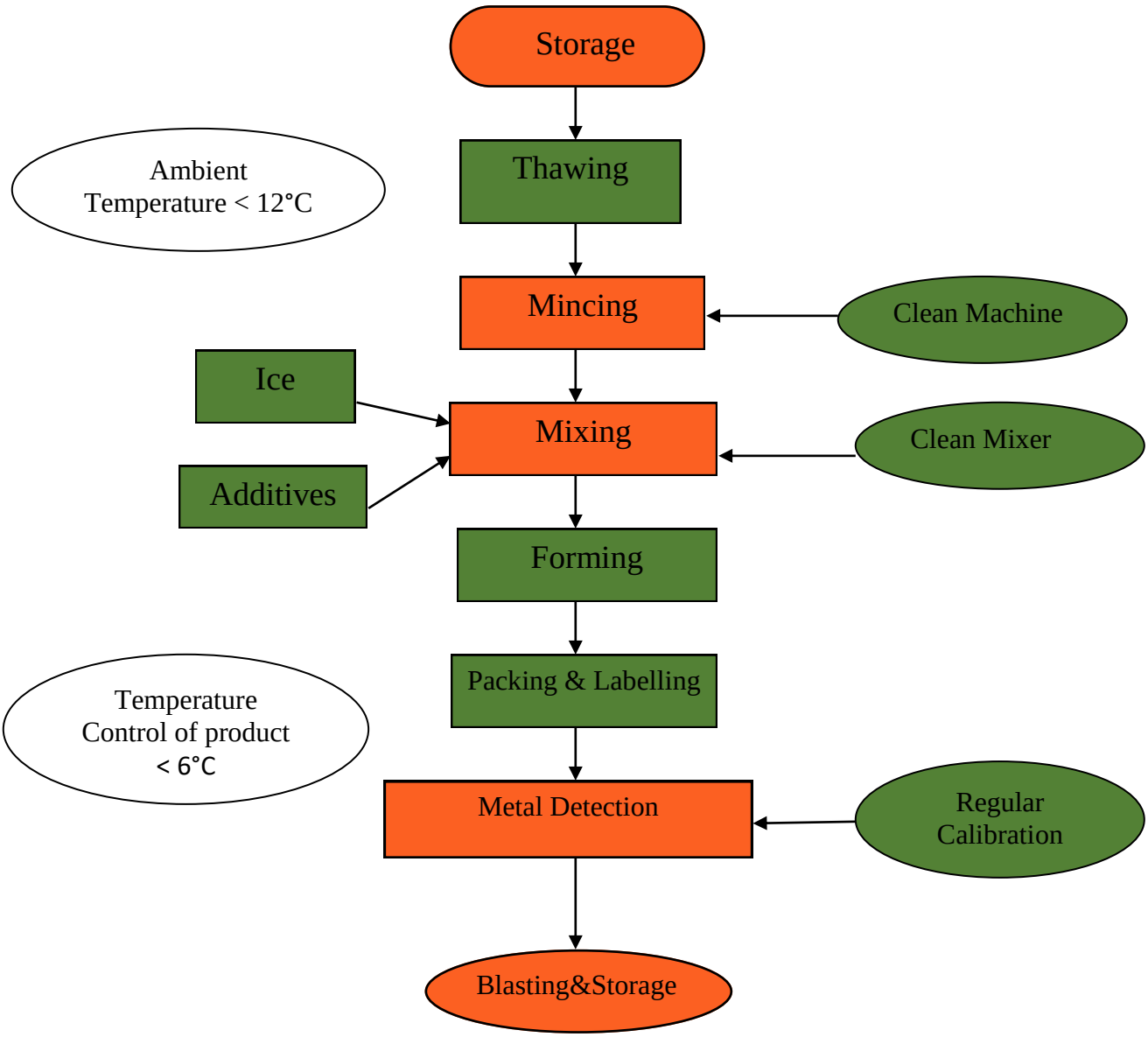
The analysis for hazards is carried out in steps, as seen in the flow chart for the production of beef burgers. For each step we ask: -

- Can there be a biological hazard?
- Can there be a chemical hazard?
- Can there be a physical hazard?

We write the justification, both if the answer is a yes or a no, based on a risk assessment. If the product stays within control, then we draw this as a green. If the step involves "red" items, then these are marked as such, to ensure that there is no cross-contamination.

Below is an example of the flow chart (as recommended in the Codex Alimentarius), Hazard Analysis and Hazard Plan :-

Production of Beef Hamburgers:



The above process is carried out in an ambient temperature of 12°C while the product must never go above the 6°C (EU Reg 853 of 2004). This maintains the level of bacteria at a low level, as high levels of bacteria can produce toxins which present a chemical hazard.

HAZARD ANALYSIS WORKSHEET

Product description: **Beef burgers (Frozen & raw). This is a beef mince patty formed in a circular flat product**

Method of distribution and storage: **Stored at -22°C to -18°C. Customers purchase & transport in own vehicle**

Intended use: **Instructions on packaging state that product must be thawed and cooked to be consumed**

Label: **Labelled in accordance to EU regulation 1169 of 2011 including ingredients, allergens in bold and best before/lot no. Customers are advised to thaw in fridge for 1 day and not to refreeze.**

1	2	3	4	5	6
Ingredient/ Processing Step	**Identify Potential Hazards Introduced, Controlled or Enhanced**	**Are any Potential Food safety Hazards Significant? Y/N**	**Justify Your decision For Column 3**	**What Preventive Measures can be Applied for the significant Hazards?**	**Is this step a CCP? Yes or No**
Storage of raw materials	Biological	Yes	Rise in temperature rise in bacteria	Cooling	Yes BI
	Chemical	Yes	Rise in temperature rise in bacteria rise in toxins	Cooling	
	Physical	No	Ingredients are boxed	None	
Thawing	Biological	No	Ingredients are in “green” boxes	None	No
	Chemical	No	Ingredients are in “green” boxes	None	
	Physical	No	Ingredients are in “green” boxes	None	
Mincing	Biological	No	Action is rapid with a good GMP	None	Yes P1
	Chemical	No	Action is rapid with a good GMP	None	
	Physical	Yes	Pieces of metal from machine	Metal detector in line	
Mixing	Biological	No	Action is rapid with a good GMP	None	Yes P1
	chemical	No	Action is rapid with a good GMP	None	
	Physical	Yes	Pieces of metal from machine	Metal detector in line	

Company name

Process or product name: Frozen Beef Burgers

Product description, intended use, distribution and storage: See Hazard Analysis Sheet

HACCP Plan for Critical Control Points

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Critical Control Point CCP	**Significant Hazards(s)**	**Critical limits For each Preventive Measures**	**Monitoring**			**Who?**	**Corrective Actions**	**Records**	**Verification**
			What?	**How?**	**Frequency**				
B1	Biological & Chemical	-12°C	Check temperature	Remote sensing	Continuous	J. Smith	Readjust temperature or transfer to other freezer	Data Tracker	J. Black
P1	Physical	Metal fragments in product	Metal detector	Validate detection	Every 15 minutes	J. Smith	Readjust & re-run last run	Sheet MD1	J. Black

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Chapter 11 – Attitude – a life changer and how it brings results in an organization

This book has been written to enhance the knowledge of the operators in food production. Skills must be learnt on site but taught by someone who is competent. Knowledge is *explicit* and tells us what we must know. In today's world, we are loaded with information, but one must select the right information as there are a lot of fake information on the internet. Skills are *tacit*, and one must become competent by making the process part of the software of his/her brain.

The Attitude part is about knowing WHY we do things the way we do. We are part of a team and we have a great responsibility in not forgetting our legal obligations. Becoming a champion of your process turns you into an invaluable person at your place of work. You will enjoy what you are doing, and you feel that you are improving the process gradually …….but surely.

In my 45 years' experience, I have seen why organizations are successful. A successful organization is made up of leaders who own their process and work to improve it. My definition of quality is that it is an overlap of Skills, Knowledge and Attitude.

The nexus represents Quality. When one improves his skills and his knowledge, the nexus increases. When we improve our attitude towards our work, then the nexus grows even bigger.

I call this - the organization becomes an organism, living and growing. At this point the organization has migrated from Quality to Excellence. Here, Total Food Safety is possible and comes without fears or tears.

It is not a question of working harder but working smarter!

Enjoy.

Joseph Tanti

Answer to question on page 3: ALL ARE TRUE

Below are some sites which are highly valuable:

- Bad Bug Book - https://www.fda.gov/downloads/food/foodsafety/foodborneillness/foodborneillnessfoodbornepathogensnaturaltoxins/badbugbook/ucm297627.pdf
- European Food Safety Authority - http://www.efsa.europa.eu/
- Eur-lex (for the European Laws) - https://eur-lex.europa.eu/homepage.html
- Food Standards Agency of the UK - https://www.food.gov.uk/
- The Food Safety Authority of Ireland - https://www.fsai.ie/
- Codex Alimentarius - http://www.fao.org/fao-who-codexalimentarius/en/
- US Food and Drug Administration - https://www.fda.gov/Food/default.htm
- Youtube – Ms Lisa Ackerley's interview with Profs Carol Wallace - https://www.youtube.com/watch?v=vTYnUiqzIR0