TS 3: THE 5M METHOD IN FOOD HYGIENE AND SAFETY

1. Definition and historical background

The 5M method is a qualitative tool used to identify and organise the possible causes of a specific problem into five main categories: Manpower, Methods, Machines, Materials and Milieu (environment). It is generally represented by a cause-and-effect diagram, also known as the Ishikawa diagram or fishbone diagram.

The diagram places the problem, or effect, at the end of a main horizontal arrow. Five main branches represent the different categories of potential causes, while secondary branches identify more specific causes and contributing factors.

The method is associated with Kaoru Ishikawa (1915–1989), a Japanese specialist in quality management. Initially developed in industrial quality control during the mid-twentieth century, it subsequently became widely used in manufacturing, services and food production.

The term 5M refers to five categories of analysis, not five successive stages or five types of food hazards.

2. Purpose and logic of the 5M method

The main objective of the 5M method is to avoid superficial explanations of food safety problems. When a non-conformity occurs, the first visible explanation is not necessarily the only or most important one. The 5M method aims to:

- Identify all possible causes of a food safety problem.
- Avoid stopping at the first apparent explanation.
- Facilitate teamwork and systematic investigation.
- Identify relationships between different contributing factors.
- Guide further investigations and corrective actions.

However, the 5M diagram does not prove causation, rank causes or quantify food safety risks. It does not replace microbiological analyses, process validation, prerequisite programmes or HACCP. Its effectiveness depends mainly on the quality of the investigation and the verification of proposed causes.

3. The five categories of the 5M method in food hygiene and safety

The five categories provide a practical checklist for exploring different parts of a food operation.

3.1 Manpower (people and human factors)

Manpower includes everyone whose work can affect food safety and hygiene, such as operators, cleaning staff, maintenance workers and transport personnel.

- Knowledge and competence: Workers must have appropriate knowledge of personal hygiene, handwashing, protective clothing, allergen management, temperature control and safe food handling.
- Personal hygiene and fitness for work: Poor hand hygiene, inappropriate clothing, uncovered wounds and failure to report illnesses may contribute to food contamination.
- Workload and organisation: Excessive workload, fatigue, insufficient staffing, time pressure and unclear responsibilities may lead to errors or incomplete procedures.
- Communication, supervision and safety culture: Poor communication, inadequate supervision and failure to report errors may allow hygiene deviations to persist.

3.2 Methods: procedures and process design

Methods include all working procedures and practices involved in food production, including processing, cleaning, storage, transport, sampling and traceability.

- Suitability and clarity of procedures: Procedures must be clear and adapted to the task, specifying responsibilities, working sequences, equipment, relevant parameters and actions in case of deviations.
- Process parameters and sequence: Food safety depends on controlling parameters such as time, temperature, pH, water activity and pressure. Incorrect parameters or inappropriate sequences may compromise product safety.
- Cleaning and disinfection: Cleaning removes food residues and dirt, whereas disinfection reduces microorganisms to an acceptable level. Their effectiveness depends on the product used, concentration, contact time, temperature and surface conditions.
- Documentation and process changes: Outdated instructions, incomplete records and failure to update procedures after process or equipment changes may lead to deviations between planned and actual practices. Verification checks whether procedures are followed, while validation confirms their ability to achieve the intended result.

3.3 Machines (equipment, instruments and technology)

Machines include processing equipment, utensils, refrigeration and heating systems, packaging machinery and monitoring instruments.

- Hygienic design and cleanability: Equipment must be designed to facilitate cleaning and prevent contamination. Cracks, inaccessible surfaces, damaged seals and corrosion may retain food residues, allergens and microorganisms.
- Condition and maintenance: Worn or damaged parts, cracked hoses, lubricant leaks and corrosion may introduce physical or chemical hazards and compromise hygiene.
- Temperature control and process capacity: Refrigerators, freezers, pasteurisers and cooling systems must maintain appropriate operating conditions. Their performance may be affected by loading, air circulation, door opening and incorrect probe placement.

- Instruments and automation: Thermometers, pH meters and other measuring instruments must be correctly calibrated and used. Incorrect measurements, damaged sensors or automation failures may lead to inadequate process control.

3.4 Materials (raw materials, ingredients, water and packaging)

Materials include raw foods, ingredients, additives, processing aids, water, ice and food-contact packaging. Their safety depends on their intrinsic properties and the conditions of reception, storage and use.

- Supplier approval and receipt: Inadequate supplier control, poor transport conditions and insufficient reception checks may introduce unsuitable or contaminated materials. Checks should include product identity, temperature, packaging integrity, shelf life and traceability.
- Biological, chemical and physical hazards: Raw materials may introduce pathogens, parasites, allergens, mycotoxins, pesticide and veterinary drug residues, environmental contaminants and foreign bodies such as glass, metal and plastic.
- Intrinsic properties and stability: Food characteristics such as pH, water activity, moisture and composition influence microbial survival and growth, depending also on storage time and temperature.
- Allergens, packaging and chemicals: Proper ingredient identification, allergen segregation and correct labelling are essential. Unsuitable packaging, chemical residues and improperly stored cleaning products may also compromise food safety.
- Storage, traceability and stock control: Poor storage conditions may cause contamination, packaging damage, pest infestation and temperature abuse. Stock rotation helps manage shelf life, while traceability allows products to be identified and withdrawn when necessary.

3.5 Milieu / Environment (premises and surroundings)

Milieu refers to the physical environment in which food is received, processed, packaged and stored. It includes premises, drainage, ventilation, water systems, lighting, waste areas and surrounding conditions.

- Layout, zoning and flows: Premises should be organised to separate incompatible activities and prevent cross-contamination between raw materials, finished products, personnel, packaging and waste.
- Building fabric, drainage and water: Damaged floors, cracked walls, leaking roofs and poor drainage may favour contamination. Water and ice must be suitable for food use, and plumbing systems must prevent backflow and cross-connections.
- Air, temperature, humidity and condensation: Poor ventilation and inappropriate temperature or humidity may favour condensation, airborne contamination and microbial growth.

- Pests, waste and external access: Building openings, waste accumulation and standing water may attract insects and rodents. Pest prevention requires good housekeeping, exclusion measures and regular monitoring.
- Environmental monitoring: Inspections, temperature and humidity records, water analyses and surface sampling help assess environmental hygiene. Results must be interpreted carefully, as a negative sample does not guarantee the absence of contamination throughout the premises.

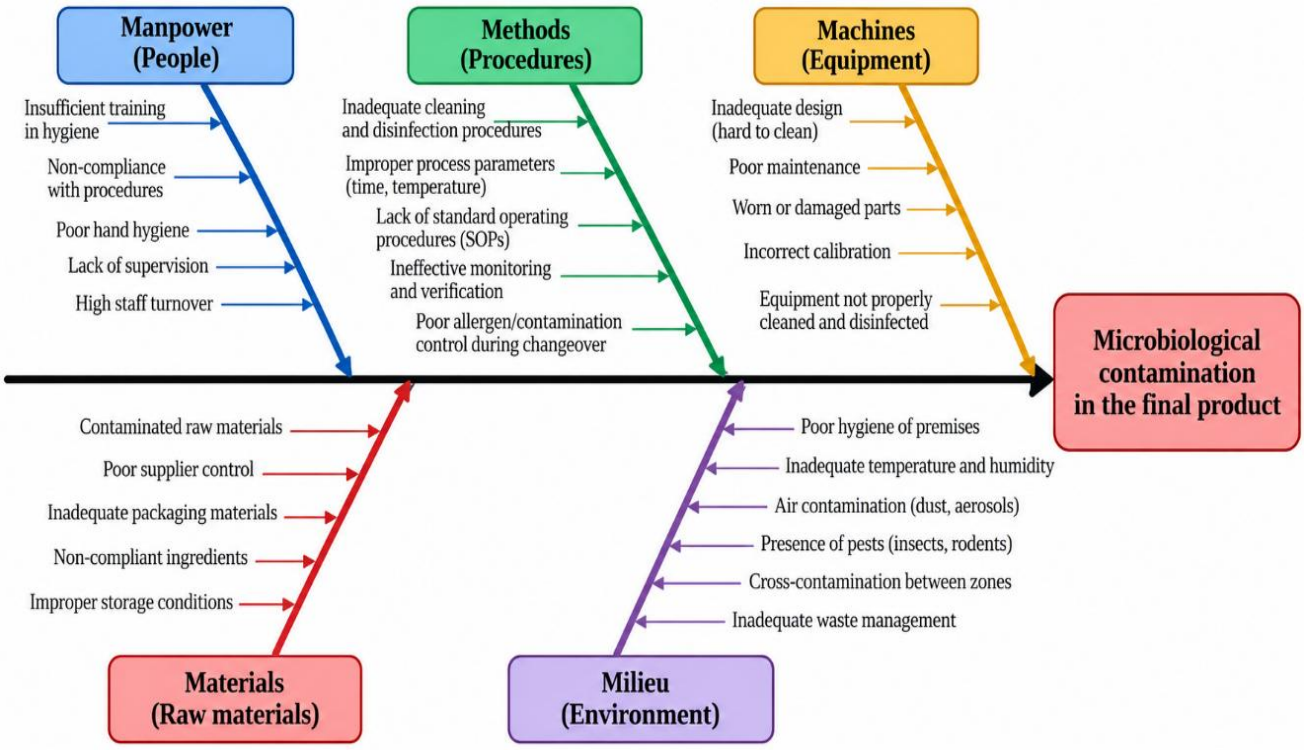


Figure 1. A schematic 5M cause-and-effect diagram

4. Integration of the 5M Method into food safety management programms

4.1 Prerequisite programmes (PRPs)

Prerequisite programmes establish the basic hygienic conditions required for food production, including cleaning and disinfection, personnel hygiene, pest control, water quality and equipment maintenance. The 5M method can help investigate why a prerequisite programme did not perform as intended. However, it does not replace the programme, its documented responsibilities or its verification.

4.2 HACCP and hazard analysis

The 5M method may support hazard analysis by identifying factors that allow hazards to enter food, survive, grow or escape control. It helps organise possible causes but does not replace HACCP, determine critical control points or establish critical limits and monitoring procedures.