

10. HOW TO REDUCE DIETARY EXPOSURE TO PESTICIDES

In previous chapters, we examined how pesticides can enter food, their potential health effects, and how the limits established by European legislation are determined. We also saw that a food can fully comply with the law while still containing quantifiable residues of one or more substances.

This raises a question of direct concern to every consumer: can we actually reduce the amount of pesticides we ingest through our diet? The answer is yes, at least for some sources of exposure.

Household practices, dietary choices, farming methods and monitoring systems can help reduce residues in food or the amounts ultimately ingested. Their effectiveness, however, varies. Some practices remove a proportion of pesticides from the surface of produce. Others change residue concentrations during food processing. The choice of raw materials and production techniques can influence the likelihood of particular residues being present. Chemical testing can also identify foods meeting defined criteria, including criteria stricter than statutory limits.

One fundamental principle must nevertheless be made clear: **no household treatment can guarantee the complete removal of every pesticide that might be present in a food.**

Reducing exposure therefore requires complementary approaches, each with its own capabilities and limitations.

10.1 Washing fruit and vegetables: useful, but not a complete solution

Washing produce is among the simplest ways to reduce unwanted substances on its surface. Running water can remove soil particles, impurities, microorganisms and some pesticide residues. How much pesticide is removed depends on several factors.

A particularly important factor is the substance's water solubility. Some pesticides are washed away relatively easily, while others adhere more strongly to plant surfaces. Fruit and leaves may have natural waxy coatings that retain certain pesticides. Surface texture also affects washing: smooth skins behave differently from rough, uneven surfaces with hollows or protective structures. Some pesticides may already have penetrated plant tissues, in which case surface washing cannot remove them completely.

Scientific studies show that washing fruit and vegetables can reduce many surface residues, but cannot guarantee removal of all compounds. Consumers should wash produce thoroughly under clean running drinking water and gently rub the surface when appropriate. A clean brush may be used for robust fruit and vegetables. Ordinary household soaps and detergents are not recommended: they are not necessarily intended for ingestion and may leave unwanted residues.

Washing is good hygiene and can reduce certain surface pesticides. A washed food, however, is not necessarily residue-free.

10.2 Peeling fruit and vegetables: benefits and limitations

Peeling may substantially reduce pesticides concentrated in the outer layers of fruit and vegetables. Many crop treatments are applied directly to plant surfaces, so residues may accumulate in the skin or layers just underneath it. Removing those layers can physically eliminate part of the residue.

Its effectiveness depends on the chemical involved. Systemic pesticides may have been absorbed and transported into the fruit, and removing the skin will not necessarily eliminate them. Another consideration is nutritional value: many fruit skins contain fibre, vitamins, pigments and other beneficial compounds. Peeling can therefore reduce certain surface contaminants while also removing nutritionally useful material. The choice should reflect the food, how it is eaten and its nutritional properties.

For some leafy vegetables, removing outer leaves may be appropriate, especially when they are damaged or particularly exposed. **Peeling can reduce specific residues, but it is not a universal solution.**

10.3 Does cooking eliminate pesticides?

Cooking changes the physical and chemical properties of food. Heat can degrade certain molecules, encourage volatile substances to evaporate, or alter their distribution. Cooking can therefore reduce some pesticide residues. Not all compounds, however, react in the same way at normal cooking temperatures. Some are relatively heat-sensitive; others are more stable and may survive heat treatment at least in part.

Boiling introduces another process: some substances can move from the food into the cooking water. Water-soluble pesticides may, under certain conditions, be partly transferred to the liquid. Discarding that liquid may remove some residue. If it is consumed—for example in soup—the transfer does not necessarily reduce total dietary exposure.

Water loss during cooking may also increase the concentration of residues remaining in the food. Reducing the product's mass can increase the measured concentration even when the total amount of the substance has not increased.

Finally, chemical degradation may produce transformation products with different toxicological properties from the parent pesticide. **The disappearance of the original molecule during cooking does not in itself demonstrate that transformation products are absent or that the risk has been eliminated.** Evaluating cooking effects requires considering the substance, the treatment and the fate of any degradation products.

10.4 What happens during industrial food processing?

Many foods are processed before consumption. Cereals are milled, fruit may become juice or preserves, oilseeds undergo extraction, and many products are dried, fermented or otherwise treated. These processes can change residue distribution and concentration.

In cereals, for example, some pesticides are concentrated in the grain's outer layers. Milling and separation can therefore produce different residue levels in refined flour, bran and other fractions.

This does not mean refined flour is always free of pesticides or necessarily nutritionally preferable. It means processing can redistribute contaminants.

A similar effect can occur during oil production. Some lipophilic pesticides—compounds with an affinity for fats—may preferentially enter the oil fraction. Other compounds may be partly removed during refining. Drying can increase the concentration per kilogram, especially when the compound remains stable as water content decreases.

These changes are described using a **processing factor**: the ratio between the residue concentration in the processed food and that in the starting material. A factor below one indicates a reduction in concentration; above one indicates an increase. Neither change necessarily proves destruction or formation of a substance, since it may reflect differences in how mass is distributed.

Industrial processing does not automatically eliminate pesticides. Depending on the circumstances, it can reduce, alter or concentrate residues.

10.5 Can organic farming reduce exposure?

Organic farming is a regulated production system that strongly restricts the use of plant protection products and prohibits many synthetic substances authorised in conventional agriculture. This does not mean organic farming uses no crop protection products: certain substances and formulations are permitted under regulatory conditions.

The distinction therefore concerns permitted agricultural practices, not a guarantee that the final product contains no chemical residues. Nevertheless, differences in farming practices can substantially affect pesticide exposure.

Several studies have investigated what happens when people who normally eat conventionally produced food switch to a predominantly organic diet. One approach measures pesticides or their metabolites in urine. Known as **biomonitoring**, this provides information about an individual's actual exposure to specific substances.

A 2019 experimental study involving sixteen people from four US families found significant reductions in several urinary pesticides and metabolites following a switch to an organic diet. Reductions were particularly marked for certain substances. A randomised trial published in the American Journal of Clinical Nutrition in 2022 likewise reported substantial differences in urinary pesticide-residue excretion between groups consuming organic and conventional diets.

These results are valuable because they go beyond comparing labels or agricultural methods: they measure biological indicators of exposure. They must nevertheless be interpreted appropriately. Lower concentrations of pesticides or metabolites in urine demonstrate changes in exposure to the compounds measured. **They do not, by themselves, prove that this reduction necessarily delivers a measurable long-term clinical benefit.** Results may also vary with the substances involved, dietary habits and environmental conditions.

The available evidence indicates that organic foods can reduce exposure to many pesticides. Organic certification, however, is not equivalent to analytical proof that all residues are absent. These are different, complementary types of information.

10.6 Environmental contamination does not recognise certification labels

A food can contain residues of compounds that were never directly used during its cultivation. As earlier chapters explained, pesticides may move through wind, water and soil. Some persistent substances can also remain in the environment for long periods.

Crops grown without certain pesticides may consequently be exposed to contamination from their surroundings, including in organic systems. Unintentional exposure can arise from spray drift from neighbouring fields, residual contamination in the soil or irrigation water carrying substances from other areas. Its probability and magnitude depend on local conditions and the chemicals involved.

It would be wrong to assume that every organic product experiences this contamination. It would be equally wrong to treat certification as an analytical demonstration of absence.

Production rules describe what a farmer is allowed to use. Testing the final product may also reveal substances reaching a crop independently of the farmer's choices. This is an important distinction in understanding food quality.

10.7 Dietary variety: a useful choice for exposure, too

A varied diet is a cornerstone of sound nutrition. Eating different food groups provides a range of nutrients and avoids undue dependence on just a few products. Variety can also influence exposure to certain contaminants.

If a particular food makes up a large proportion of the diet, repeated occurrence of one substance in that food may contribute considerably to overall exposure. Alternating foods may reduce reliance on a single source, but the effect is not automatic. Different foods may contain the same pesticide—or different compounds contributing to cumulative exposure.

A more varied diet therefore does not guarantee a reduction in total exposure to every pesticide. Estimating exposure requires information about which substances are present, their concentrations and the amounts actually consumed.

Variety nevertheless remains sensible for balanced nutrition. Concerns about pesticides should not lead people to unnecessarily reduce their consumption of fruit, vegetables and other nutritionally important foods. **Reducing contaminant exposure must not come at the cost of dietary quality. The aim is to choose better, not indiscriminately abandon entire food groups.**

10.8 The importance of farming practices in prevention

Some exposure reduction can be achieved before food is even harvested. Farming practices influence the type and amount of plant protection products used.

A central tool is **Integrated Pest Management (IPM)**, which combines agronomic, biological, physical and chemical approaches to prevent and control harmful organisms. The objective is to keep interventions at levels justified by actual production needs.

Available measures include crop rotation, resistant varieties, biological control, pest monitoring and targeted use of plant protection products when needed. Prevention can reduce the need for repeated treatments. Better application equipment can also limit waste and dispersal.

However, using less product does not automatically produce a proportionate reduction in risk. Different chemicals vary greatly in toxicity, persistence and environmental behaviour. A smaller quantity of a more hazardous substance does not necessarily pose less risk than a larger quantity of a less hazardous one. Reduction strategies must consider both the amounts used and the hazards and exposure conditions involved.

Contamination prevention starts with agricultural decisions, not at the kitchen sink. Some of the most important results can be achieved at this earlier stage.

10.9 The role of information available to consumers

When purchasing food, consumers can generally read ingredients, nutritional information, origin where required, and other details on the label. They rarely have access, however, to a list of chemical substances potentially present as residues.

European legislation specifies what must be disclosed and which requirements products must meet. It does not normally require full analytical results to be published for every marketed batch. This is consistent with a system designed to monitor compliance and manage risk across the market, but it leaves an information gap for individual consumers.

A consumer may know that a product can legally be sold without knowing the actual concentrations of any residues in it. The difference becomes clear when comparing two batches of the same food: both may comply with the law yet contain very different amounts of the same pesticide. Without batch-specific testing, consumers ordinarily cannot know that difference.

Access to analytical certificates therefore adds another dimension to food choice. **Knowing that a food complies with the law provides regulatory assurance. Knowing which substances were tested for, and the actual findings, provides additional information.** The second does not replace the first, but enables more individualised and detailed selection criteria.

10.10 Analytical batch selection as a way to reduce exposure

A food selection system based on laboratory testing can apply criteria stricter than mandatory legal limits. For example, a protocol may test for hundreds of pesticides and reject a batch whenever a substance subject to a non-quantification criterion is measured at or above that substance's **limit of quantification (LOQ)**.

This selects products meeting an additional analytical requirement beyond legal compliance. The finding must still be interpreted correctly. A pesticide that is not quantified may nevertheless be present below the method's LOQ. A multi-residue protocol covers only the substances actually included in its analytical list. The representativeness of the sample for the entire batch is another essential consideration.

Rigorous testing therefore requires appropriate sampling procedures, competent laboratories, validated methods and clearly stated LOQs. Transparent reporting helps consumers understand exactly what has been checked.

Such a system does not automatically prove that a product selected using stricter criteria produces a measurable health benefit compared with a merely legally compliant food. Establishing a clinical benefit would require specific studies. It does, however, achieve a concrete and verifiable objective: selecting food in which the compounds tested do not reach the concentrations defined as exclusion thresholds.

When applied correctly, these criteria can help reduce intake of the substances concerned compared with consuming products containing larger quantities. Actual reduction in total exposure still depends on the overall diet and other contamination sources.

Complementary strategies for reducing exposure

WASHING

May remove some surface residues
Does not remove absorbed residues

PEELING

Removes some outer-layer residues
Can also remove valuable nutrients

COOKING

May degrade or transfer residues
Effects depend on each pesticide

BATCH TESTING

Quantifies substances covered by the test
Does not prove absolute absence

Best approach: prevention + household practices + analytical information.

10.11 What can consumers do in practice?

Scientific knowledge points to several practical steps that may reduce dietary pesticide exposure. Washing fruit and vegetables thoroughly under running water is useful, also for general hygiene. Peeling, when appropriate, may reduce compounds concentrated in outer layers. Cooking and processing may change residue concentrations, although their effects depend on the compounds and methods involved.

Choosing food from production systems that restrict certain pesticides may lower exposure to some substance families, as demonstrated by several biomonitoring studies. A varied diet can reduce dependence on individual food sources, although it cannot guarantee lower total exposure. Where available, reliable batch-specific laboratory results provide more information about food composition.

These measures are not equivalent. **Washing acts on food already produced. Agricultural practices seek to prevent or limit contamination. Testing measures the residues included in a protocol and permits selection criteria to be applied.** The most complete strategy combines prevention, good household practices and analytical knowledge rather than relying on a

single measure.

10.12 Reducing exposure does not mean living in fear

Discussions of pesticides often fall into two opposing narratives. One treats regulatory compliance as sufficient reassurance for every question about food's chemical quality. The other interprets any detectable residue as an immediate threat to health. Neither reflects the scientific complexity of the subject.

The presence of a pesticide does not automatically establish a significant health risk. Risk depends on the substance, its concentration, the amount ingested, exposure duration and individual characteristics. At the same time, legal compliance does not mean that residues are absent or that all possible contaminants have been identified.

Scientific knowledge also evolves. Some effects of chronic exposure and mixtures remain under investigation. These uncertainties do not justify declaring every food containing residues dangerous. They do support the development of tools that reveal more about food composition and, where possible, help avoid unnecessary exposure.

Prudence does not require fear of food. It requires understanding what we can know, while recognising clearly what remains unknown.

Conclusion to Chapter 10

Reducing dietary pesticide exposure is an achievable goal, but no single solution eliminates every residue. Household practices can remove some substances, especially those present on food surfaces. Processing can reduce, alter or concentrate residues, depending on chemical properties and methods. Farming practices act upstream by reducing the need for treatments and favouring preventive approaches.

Raw-material choices influence exposure, as studies have shown reductions in several pesticides and urinary metabolites after a shift towards organic diets. Detailed analytical protocols enable food to be selected using measurable, verifiable criteria.

None of these measures, taken alone, guarantees the absolute absence of contaminants. Nor does a lower measured concentration automatically demonstrate a particular clinical benefit. More complete information can nevertheless support better-informed choices.

Meeting legal limits is essential. The ability to understand and further reduce residues offers an additional level of choice. This is not about setting consumers against scientific institutions. Food safety authorities assess and manage risks at population level; research, analytical technology and voluntary transparency initiatives can broaden our knowledge of individual products. These approaches are different and can complement one another.

The challenge is not to promise food entirely free from every risk. It is to provide ever better tools for understanding what we eat. **Food safety rests on science. Excellence can emerge from going beyond minimum requirements through knowledge, measurement and verifiable criteria.** Above all, greater knowledge should not mean giving up the pleasure of eating: it should mean being

able to choose more freely.

Scientific and institutional sources

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