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NPTEL ONLINE CERTIFICATION COURSES

Organic Farming for Sustainable Agricultural Production

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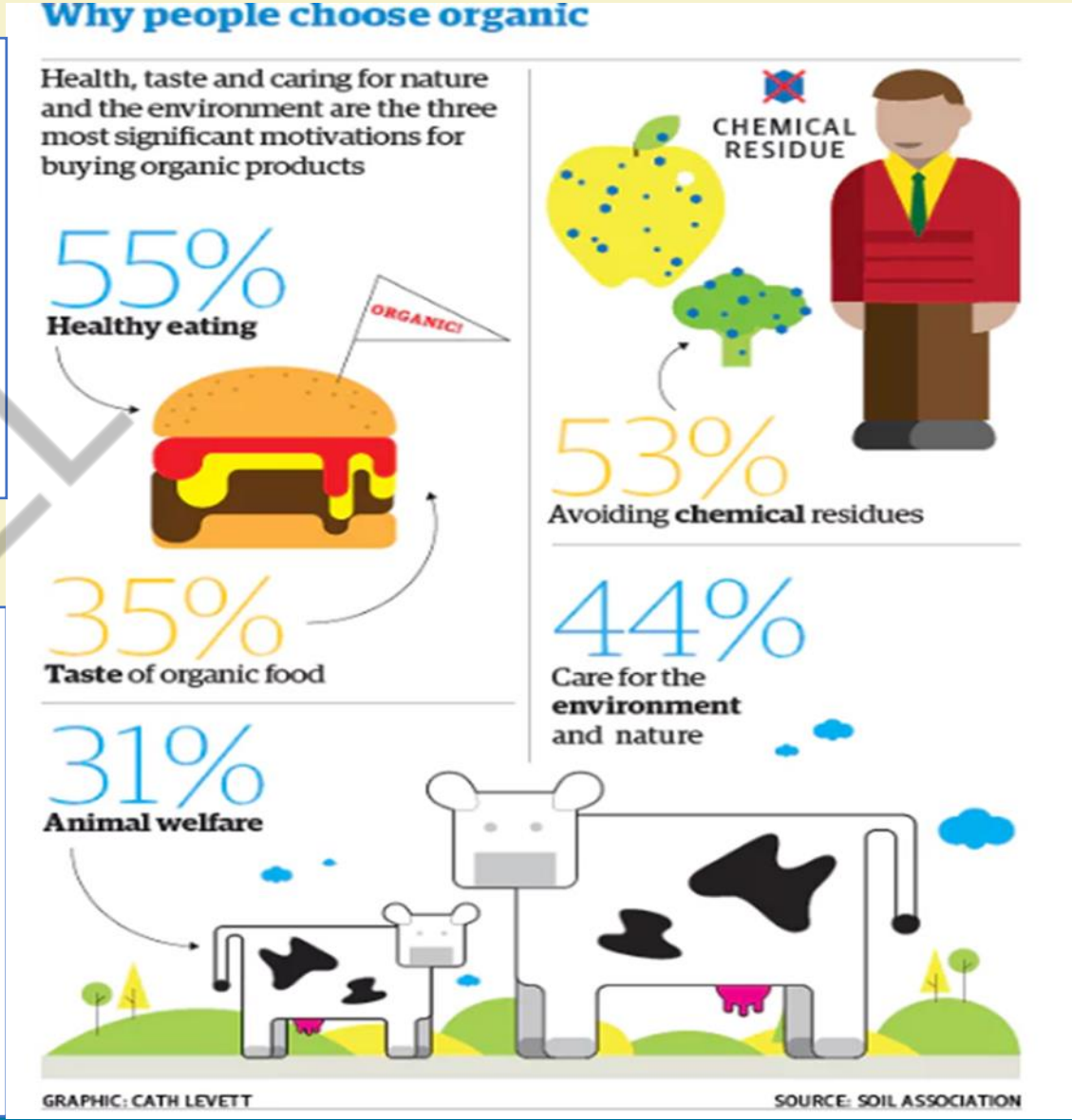
Lecture 33 : Quality of Organic Food

Since the 1920s, when chemical fertilizers were first used commercially on a large scale, there have been claims that agricultural chemicals produce less healthful and less nutritious food crops. By the 1940s, the organic farming movement had begun, in part due to this belief that food grown using more traditional, chemical-free methods was more healthful. Foods grown by these methods came to be known as "organic."
Worthington, 1998

Food Quality

- Quality is the measure or expression of goodness
- The distinctive trait, characteristic, capacity of a product that sets it apart from all others.
- Food quality is the quality characteristics of food that is acceptable to consumers. This includes external factors as appearance (size, shape, colour, and consistency), texture, flavour, and internal (chemical, physical, microbial).

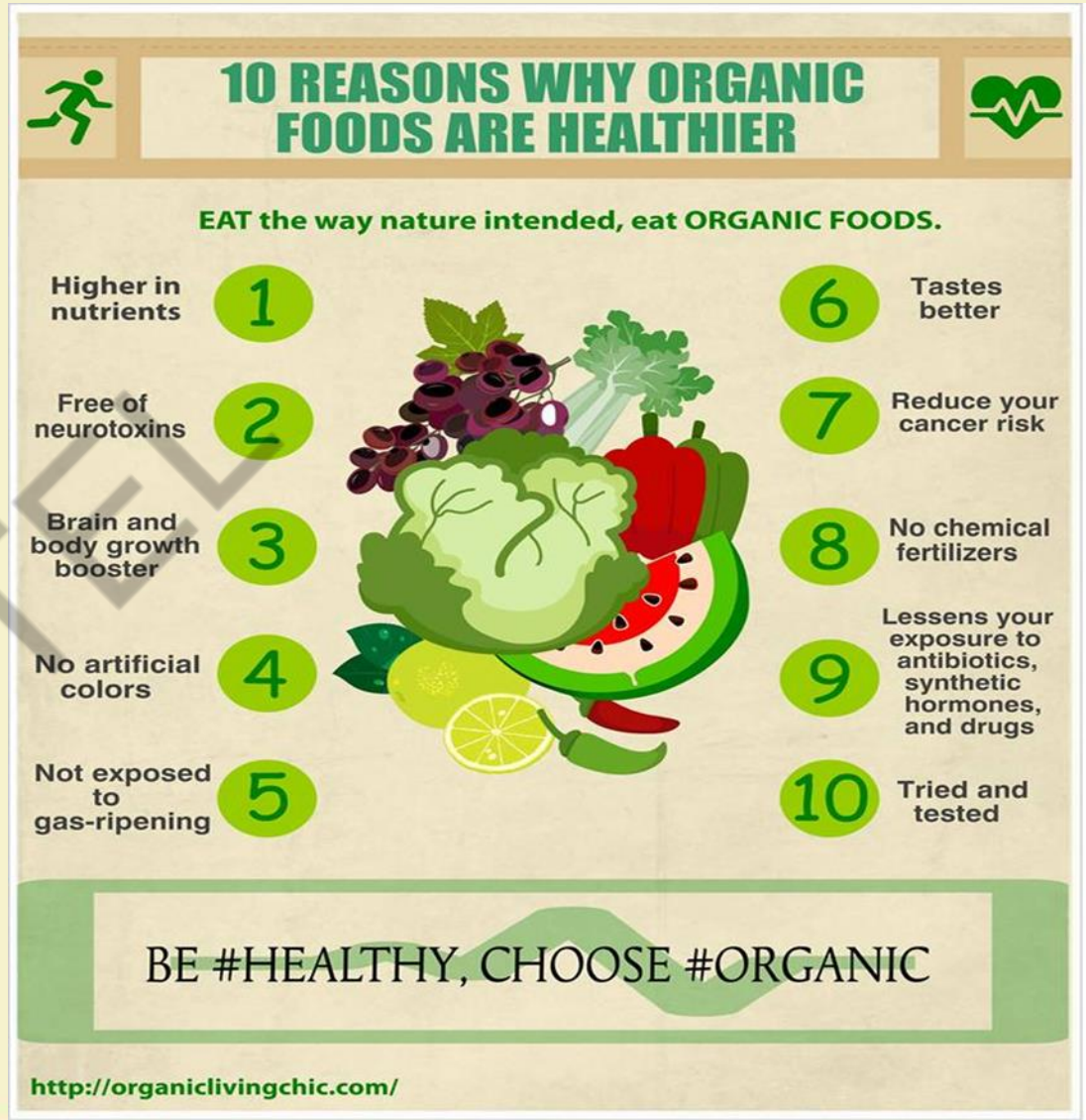


1. Nutritional Quality

It can be accessed through:

a. Primary essential nutrients such as water, fiber, proteins, fats, carbohydrates, vitamins, dry matter, and minerals

b. "Secondary metabolites" or "phytonutrients" in plants. There are some 5,000–10,000 secondary compounds in plants which are considered as health-promoting and protective and thus necessary for health. There are major four categories of phytonutrients phenolic, terpenes, alkaloids, and sulfur containing compound.



Some evidences…

- Conventionally produced crops had a significantly higher content of nitrogen, and organically produced crops had a significantly higher content of phosphorus and higher titratable acidity (Dangour *et al*. 2009)

- On the basis of a systematic review of studies of satisfactory quality, there is no evidence of a difference in nutrient quality between organically and conventionally produced foodstuffs. The small differences in nutrient content detected are biologically plausible and mostly relate to differences in production methods (Dangour *et al*. 2009)

- A 25–30% increase in lysine has been reported in organic wheat (Brandt et al., 2000). Comparative studies performed on hen eggs (Kouba, 2002) and raw cow's milk (Toledo et al., 2002) did not show any noticeable difference in protein levels.

- According to Brandt et al. (2011), who conducted a meta-analysis of the published comparative studies of the content of secondary metabolites in organic vs. conventional crops, organic ones contain 12% higher levels of favorable secondary metabolites than corresponding conventional fruits and vegetables.

- Organic crops overall contained 21% more iron and 29% more magnesium than their conventional counterparts (Rembialkowska, 2007), .

- Organic plant products tend to have more dry matter, some minerals (Fe, Mg) and anti-oxidant micronutrients (phenols) while animal organic products have more polyunsaturated fatty acids (Dangour *et al*. 2009)

- No significant difference in protein content, but higher amylose content of rice grain was noted in organic fertilizer application as compared to chemical fertilizer (Kumar et al., 2018).

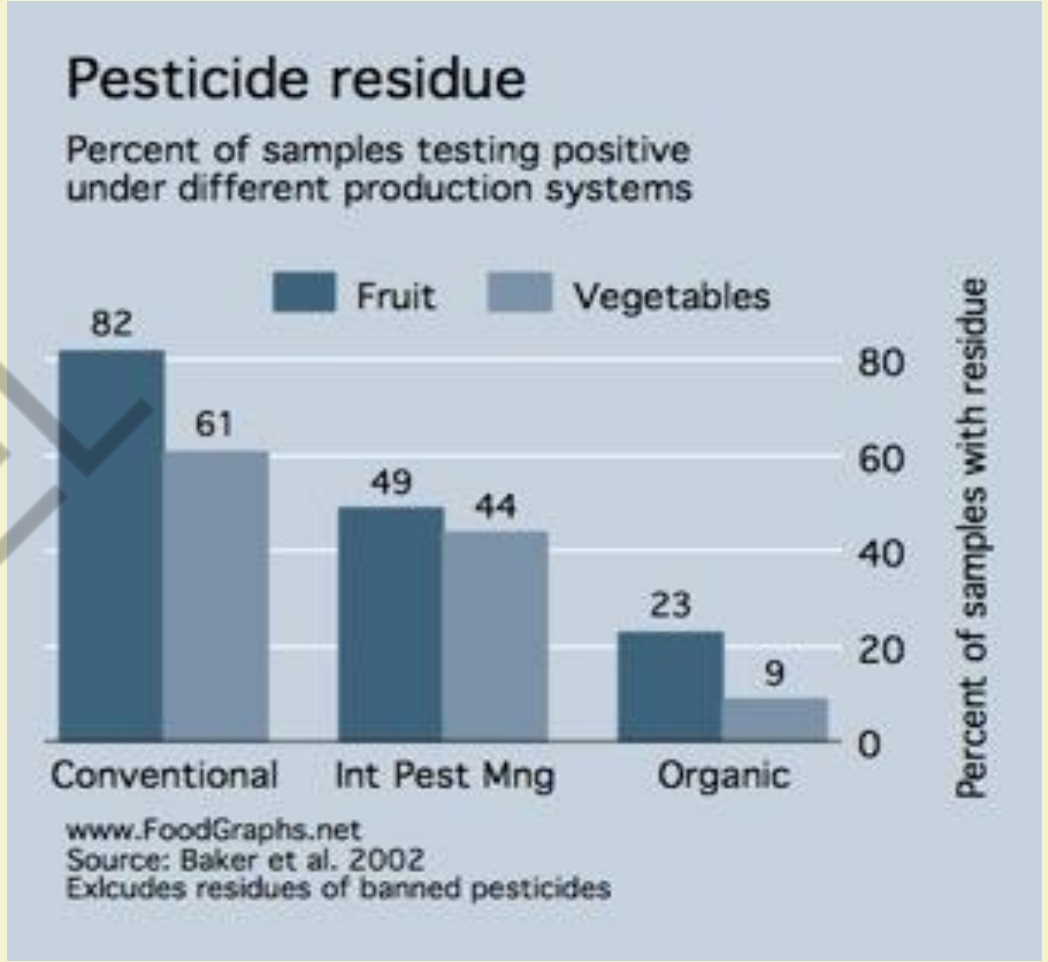
Comparison of content of nutrients and other nutritionally relevant substances in organically and conventionally produced crops

Nutrient	Comment
Nitrogen	Conventional
Vitamin C	No difference
Phenolic compounds	No difference
Magnesium	No difference
Calcium	No difference
Phosphorus	Organic
Potassium	No difference
Zinc	No difference
Total soluble solids	No difference
Copper	No difference
Titratable acidity	Organic

Dangour, A.D. Dodhia, S.K. Arabella, H. Allen, E. Lock, K. and Uauy, R. 2009. Nutritional quality of organic foods: a systematic review. Am J Clin Nutr. 90:680–5.

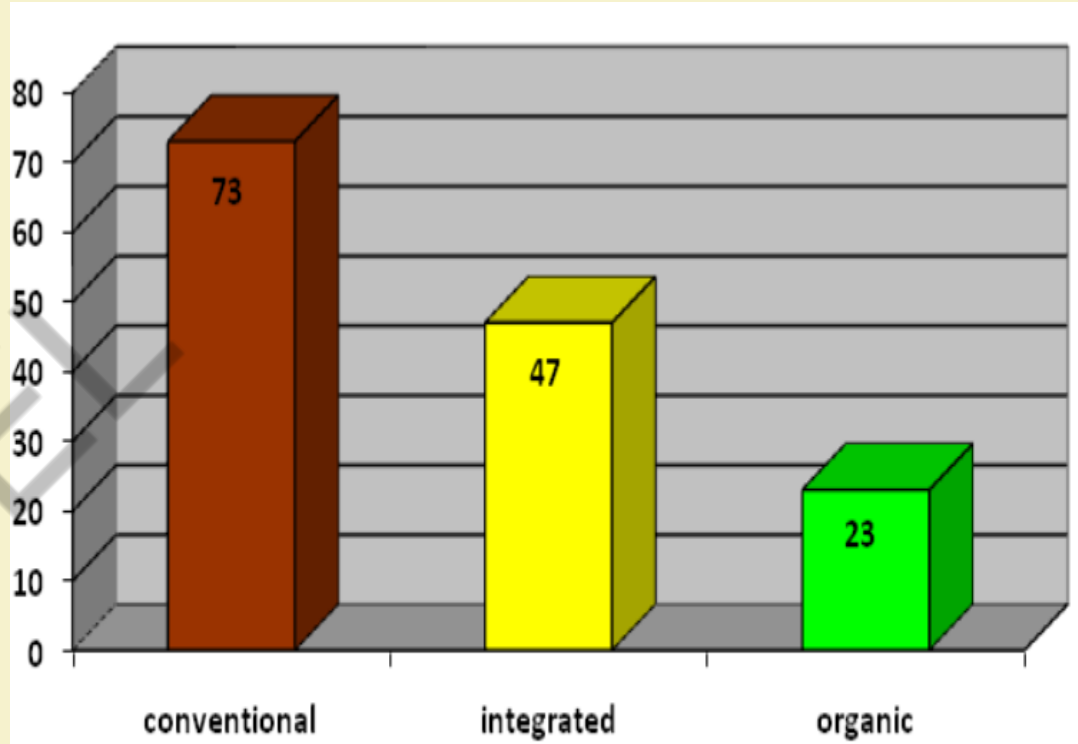
2. Pesticides Residues

- Pesticides are used to protect crops against insects, weeds, fungi and other pests.
- Pesticides are potentially toxic to humans and can have both acute and chronic health effects, depending on the quantity and ways in which a person is exposed.
- To protect food consumers from adverse effects of pesticides, WHO reviews evidence and develops internationally-accepted maximum residue limits.



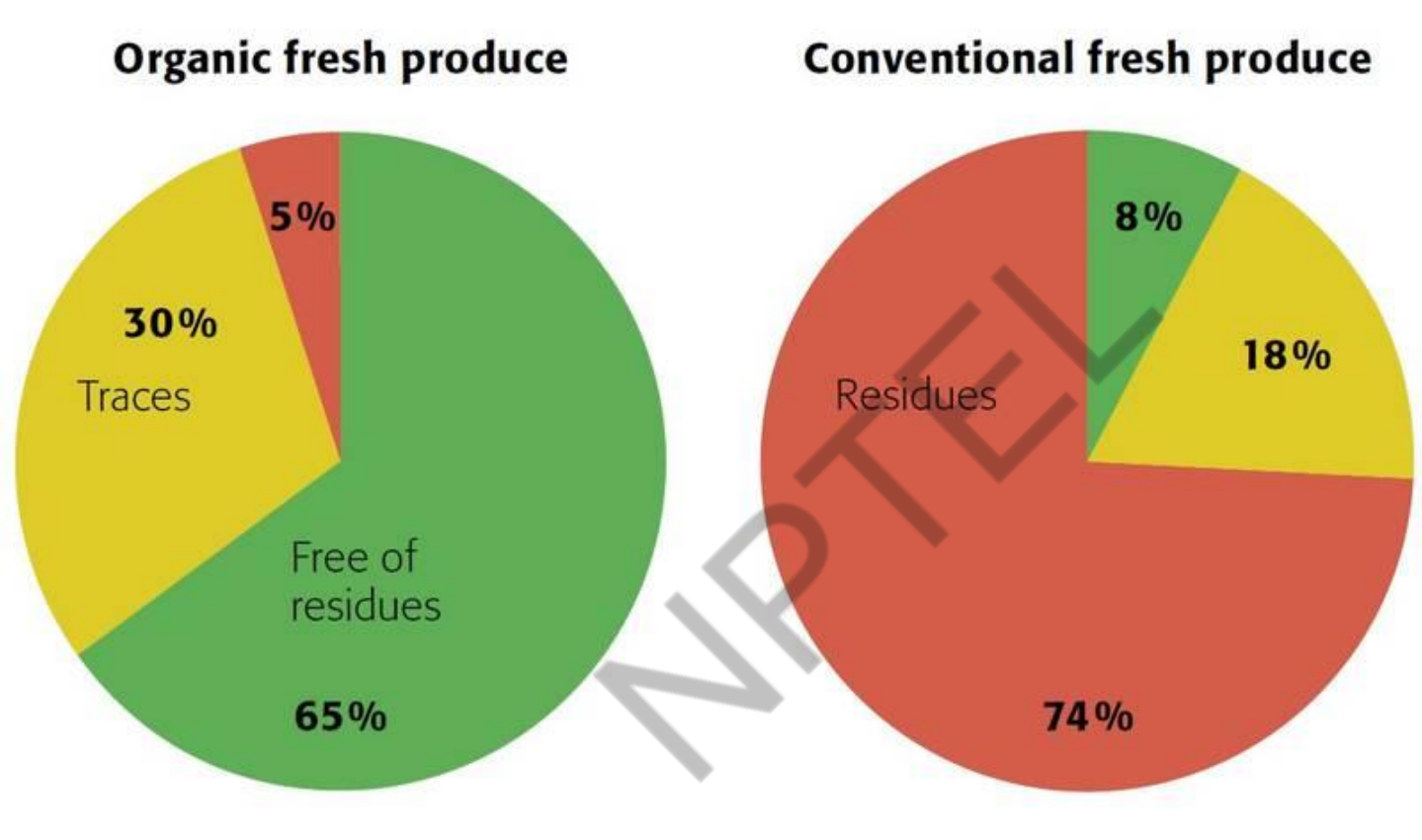
Some evidences…

- Organic produce is less likely to have detectable pesticide residues than conventionally grown produce (Baker et al. 2002)
- Among samples with any residues, conventional foods are more likely to have multiple residues in a given sample than organic foods (Baker et al. 2002)
- When present, residues in organic foods are likely to be at lower levels than those in non-organic foods (Baker et al. 2002)
- The vast majority (94–100%) of organic food does not contain any pesticide residues, organic vegetables contain markedly less nitrates (about half).



. The comparison of contamination of agricultural crops with pesticide residues in the USA (in %) (Baker et al., 2002)

Pesticide residues on organic and conventional fruits and vegetables



3. Nutrient bioavailability

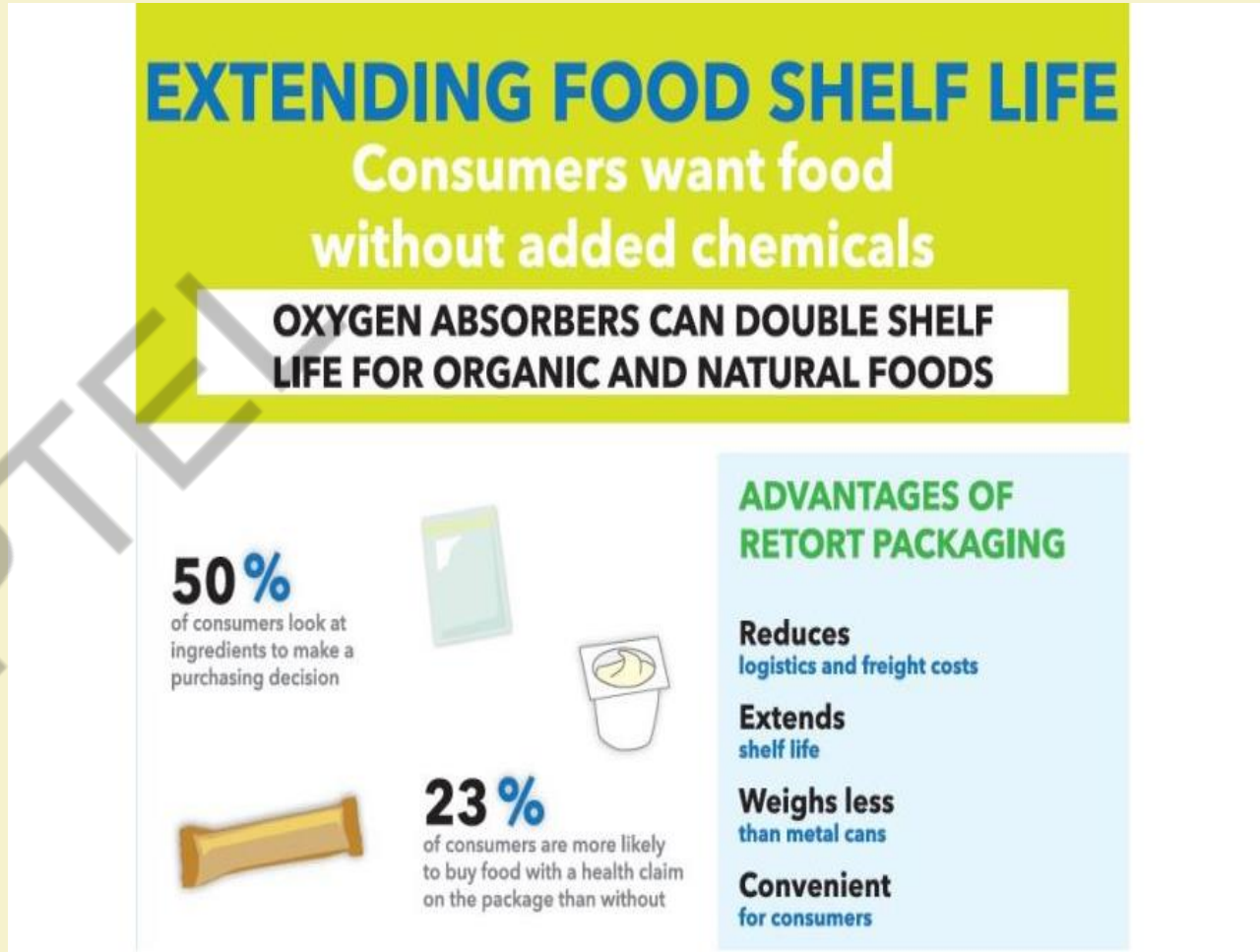
- Food digestibility and nutrient bioavailability are at the heart of nutrition.
- Digestibility is a measure of how much nutrition a food provides in a given volume.
- It indicates how much of the food is absorbed by the gut (intestines) into the bloodstream.

Some evidences…

For leafy vegetables as well as root vegetables and tubers, a trend for higher dry matter contents in organic foodstuffs has been found while no significant difference has been identified for fruit vegetables and fruit (Bourn and Prescott, 2002; AFSSA, 2003).

4. Storage quality

Vegetables, potatoes and fruits from organic production show better storage quality during winter keeping. The possible reason is connected with higher content of dry matter, minerals and total sugars.



5. Sensory evaluation

Identification of food product properties

•Scientific measurement of food product

•Analysis and interpretation of the identified and measured food product properties

Some evidences…

Organic plant products have usually better sensory quality – they have more distinct taste and they are sweeter and more compact because of higher dry matter content

Sensory Panel Rooms

Comparison of weight gain and reproductive performance in rodents and rabbits fed organic or conventionally-grown feed

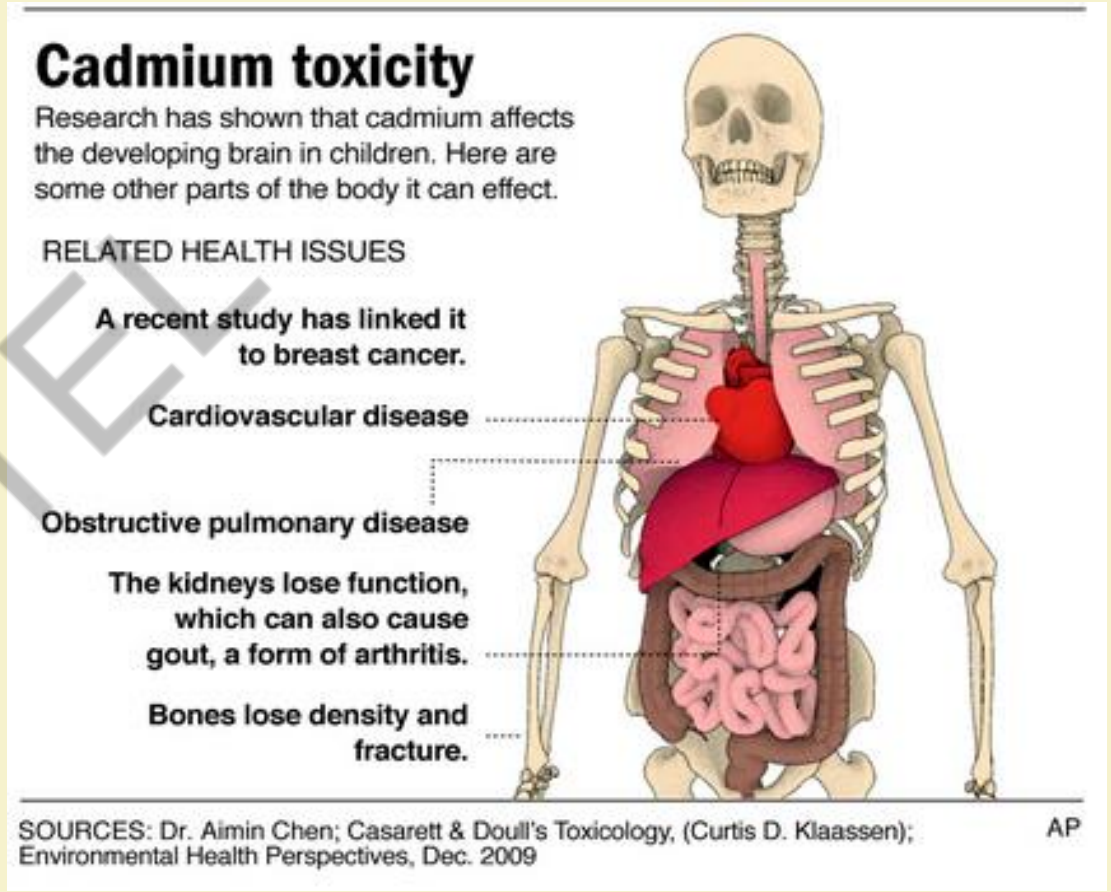
Species	Study	Animals fed organic feeds showed:
Rats and mice	McCarrison (1926)	Greater weight gain
	Rowlands & Wilkinson (1930)	Superior weight gain
	Scheunert *et al.* (1934)	Shorter lifespan, worse health
	Miller & Dema (1958)	No difference in weight gain or reproduction
	Scott *et al.* (1960)	Better reproduction with organic feeds; worst performance with mixed organic and conventional feed
	McSheehy (1977)	No difference in weaning weight
	Neudecker (1987), Velimirov *et al.* (1992)	No differences in gestation rate, litter weight or weaning weight. Lower stillborn and perinatal mortality
Rabbits	Hahn *et al.* (1971), Aehnelt & Hahn (1973), Aehnelt & Hahn (1978)	Greater no. of eggs, higher fertilisation rate, beneficial histological changes in female genital organs
	Bram (1974), Alter (1978), Meinecke (1982)	No differences in reproductive performance, ovaries, uterus
	Gottschewski (1975)	Lower mortality of newborn
	Staiger (1986)	Long-term fertility rate (three generations) higher
	Edelmuller (1984)	More young born alive

Williams, C. M. 2002. Nutritional quality of organic food: shades of grey or shades of green?. Proceedings of the Nutrition Society, 61, 19–24

Some things to be concerned about….

- Researchers found much higher levels of cadmium, a toxic metal, in conventional crops. Pesticide residues were found on conventional crops four times more often than on organic food.

- According to EPA, it is estimated that 90% of fungicides, 60 % of herbicides and 30 % of pesticides used in conventional food crops are carcinogenic.



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